A COMPARITIVE STUDY OF CAPSULORHEXIS, LINEAR CAPSULOTOMY AND CAPSULOPUNCHURE TECHNIQUE FOR PLANNED ECCE WITH PC IOL IMPLANTATION

THESIS

FOR

MASTER OF SURGERY
(OPHTHALMOLOGY)

BUNDELKHAND UNIVERSITY
JHANSI (U.P.)

2000 **SHEFALI GUPTA**

Dedicated

To

My Mother Inlaw

Department of Ophthalomogy ,
M.L.B. Medical College Jhansi (U.P.)

CERTIFICATE

This is to certify that the work entitled "***A COMPARITIVE STUDY OF CAPSULORHEXIS , LINEAR CAPSULOTOMY & CAPSULOPUNCTURE TECHNIQUE FOR PLANNED ECCE WITH PCIOL IMPLANTATION***" Which is being submitted by **Dr.Shefali Gupta,** as a thesis for MS(Ophthalomogy) examination, was carried out in the Department of Ophthalomogy, MLB Medical College Jhansi .

She has put in the neccessary stay in the department as per University regulations .

Dated : 1/3/2000

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Shefali Gupta

SHEFALI GUPTA

1/3/2000

CONTENTS

INTRODUCTION

INTRODUCTION

Cataract is one of the most important cause of visual disability in our ageing population . The surgical technique of catract surgry and visual rehabilitation of the surgery has come long way since ancient times of Indians & Egyptians in form of reclination , depression or couching (Stallard) or since the 1'st recorded intra-capsular cataract extraction by Charles Saint Yves in 1772 .

A successfully performed cataract extraction is only the first step in visual rehabilitation of the patient. The traditional method of correcting aphakia by using spectacles has many difficulties i. e.magnification by 30% . reduced peripheral field of vision and severe state of spatial disorientation of the patient .

The most exciting development in the field of cataract surgery in recent past has been the use of intra-occular lens implant (IOL) . which is free from all the optical problems of the spectacles and physical problems of contact lens .

Harold Ridley was the first to concieve the idea of IOL implant and used it for the first time in 1949 . Ridley (1951) correctly postulated that the cataractous human lens would be best replaced by an immobilised artificial one at or near the location of human lens . IOL

implantation initially done along with an extra - capsular cartaract extraction . This further steered the evolutionary surgical procedures & methods to extracapsular methods encouraged by teaching and examples of Kelman (1967) , Pearce (1975) , Shearing (1977) and Rosen (1990) .

It was not untill 1977 when shearing introduced his J loop posterior chambers lens which was essentially a modification of original barraquer anterior chambers lens, the PCL started to enjoy their present day popularity. Various other types and modifications of posterior chambers lenses i.e. C loop modified J loop etc.have been developed. Other types of lens are the anterior chamber, angle fixated, iris supported & iridocapsular implants, of all these posterior chambers lens have been most promising. In the past few years there have several modifications.

Ions in design & techniques of implantation of posterior chambers lens & in the search for a perfect procedure with long term stability. Interpreting consideration have assumed a special importance. There has been considerable debate over whether the loops of posterior chambers lens should be replaced in the cleft formed between the posterior capsule and anterior capsule remnant (In the bag) or slide it between the anterior

capsule remant and the iris to rest in ciliary sulcus . Argument in favour of "in the bag" placement are related to a concern that the contact with soft ciliary tissue might lead to various complications whereas the capsular bag being a non-viable vascular tissue would minimize these complication . In favour of ciliary sulcus placement is surgical simplicity of placement ,whereas " in the bag " the surgeon is not salvaging the capsular flaps that may interfere with cortical clean-up .

Taking into account all the studies done in the above regard the evidence is in favour of " in the bag" placement as a surgery of choice as regarding less complications in short term and long term post-operative period . Different methods have been described for anterior capsule surgery which is the first step in a a successful extra -capsular cataract extraction namely capsulopuncture technique , envelope technique and recently described continuous curvilinear capsulorhexis . Till recently envelop technique was probably the choicest of all for ensuring an "in the bag " placement . Till Gimble in 1984 & Neuhan in 1985 described a method of capsulotomy i.e. the capsulorhexis , this is a greek word where hexis means to tear .

Capsulorhexis through difficult to perform initially , seems to be an ideal way to secure long term capsular fixation & centration of a PC IOL . Assia et al (1991) . An unwelcome consequence of cataract surgery is an alteration in corneal curvature resulting in an astigmatic

REVIEW OF LITRATURE

AIMS AND OBJECTIVE

1. To evaluate the peroperative surgical problems during continous curvilinear capsulorhexis , linear capsulotomy and capsulopuncture technique with planned ECCE with PCIOL such as :-

(i) Creation of capsular flap .

(ii) Nucleus delivery .

(iii) Removal of cortical matter .

(iv) Insertion of PCIOL .

(v) Rupture of posterior capsule etc.

2. To study the intra-ocular lens centration in the posterior chamber with continous curvilinear capsulorhexis method , linear capsulotomy method and capsulopuncture technique .

3. To evaluate the visual outcome at 3 months follow up and any other significant findings .

REVIEW OF LITERATURE

ANATOMY:

CILIARY SULCUS : The concept of ciliary sulcus was first mentioned by shearing (1978) when he described the insertion of IOL. This anatomical site can be describe as a recess or deperession in the transition of posterior part of the iris into the ciliary body, before the ciliary prosses begines. A circumferential groove extends between the posterior surface of the iris root and the ciliary processe which becomes evedent upon dissection. This groove is termed as ciliiary sulcus Stefni (1985). It could be one of the many potential sites in the space between the iris root anteriorly and the ciliary processes with the zonules posteriorly were a PCL. Can be fixated Hoofer(1981) .

CAPSULAR BAG : It is generally accepted today that the better location of the IOL is in the lense capsular bag Apple D.J.(1984) . Equatorially this casular bag measures approximatly 9.6mm and 4.5 mm anterposteriorly Apple D.J. (1989). The dimension of the bag depends on the volume of its contents. Therefore certain qualities change after ECCE and the new capsular bag dimension increases to 10.5 -10.7 mm Blumenthal (1990). This is due to centrifugal zonule traction and relaxation of equatorial part of capsule Freeman in 1978 gave the concept of "capsular

compliance" indicating that the capsule will stretch to accept a larger lens. The posterior capsule is much thinner (3 µm - 4µm) than anterior (10 -15µm) . Asia & Legler have further suggested that if zonules are intact the capsular bag cannot stretch more than 12 mm. Thus it is unnecessary for IOL diameter to be more than 12 mm if secure fixation assured in the bag. Assia & Legler (1991) .

LENS CAPSULE EQUATORIAL ZONE : The germinal epithelium of crystalline lens is located at the eqautorial zone of its capsule. This makes removal under direct vision a phyical immpossibitity and therefore lens fibre generation is always prone to occur even though the surgical procedure is meticulous .

ZONULES : The supporting ligamentous apparatus for the crystalline lens is the zonules , an encircling arrangements of fine fibres. Its function is well known in terms of accomodation and support and it is in this latter capacity that may be compromised during cataract surgery as a result of inappropriate caspsular surgery.The shape and optimal size of the capsulotomy are related to the zonular junction with anterior capsuleBluementhal (1990).The zonular fibers are attached 1.0-1.5mm to the posterior capsule and 2.0-2.5mm on the anterior capsule.Their direction is perpendicular to the equator and their junction creates a zonular lamella, leaving 6.0mm zonule free area on the anterior capsule. Streeten snd pulaskai (1988)

demonstrated that the anterior zonules encroach closer to the center of the anterior lens surface than previously assumed and the central zonule free zone decreases in size with age Farnsworth (1979) .

SIZE OF IMPLAT : The commenPCLs used at present are of 13.5-14.0mm (Loop to loop) diameter. The leading principle guiding this is to avoid decentration as the location of the loops can not be secured in the bag with certainity during surgery.Blumenthal (1990).

HISTORY : The history of cataract surgery can be traced back to ancient times by Indians egyptians and Greeks in the form of reclination, depression or 'couching'.Jaques David pioneered the technique of extra capsular catract extraction in middle of eighteenth century (Devid 1753). It was practised with some modifications till early twentieth. Century when the intracapsular surgery became popular . In 1930 this technique was reinforced by use of Alpha chymotrypsin by barraquer (1958) and cryoextractions by krawicz (1961) . Charles kelman (1967) introduced the technique of phacoemulcification using ultrasonic energy, to emulcify the nucleus fragments and aspirated through a small section.

Ridley in 1949-Nov 29 implanted the first modern intraocular lens, a posteroir chamber lens. The original idea of an IOL was to have optic centered within the pupillary area behind the iris, in the capsular bag in the vicinity of the original lens. Ridleys implants were big

and heavy and associated complications of glaucoma ,Hyphema , Iritis etc.(Ridley 1960).

These disadvantages led to various modofications and nearly 45 years later what has happned in between is an explosion in technological advancements and new methods with new types of surgeries and diffrent types and sites of fixation of IOL implants in the eye ball.

POSTERIOR CHAMER IOLS

ADVANTAGE: The interest in the posterior chamber lens was revived in mid 70s and the first J-Loop Posterior Chamber was Implanted by shearing (1978) .The most importent advanteges of the posterior Chamber Lenses was Described by Jaffe(1979) as :-

1. It has the greatest sepration from the cornea and anterior chamber angle thus reducing the chances of corneal edema ELLINGSON (1977)

2. It permites free mobility of the pupil and adequate mydriasis for Opthalmoscopic examination .

3. Optical aberrations like image magnification , Lens edge glare , Glitter ,Dazzle , Fllutter have been virtually eliminated with posterior chamber Lenses .

4. They demonstrate less Pseudophakodonesis then a prepupillary lens implant .

5. Universal application i.e. even in children where other types of lenses are not very popular .

6. Near ideal position to the natural position of the lens.

COMPARITIVE ANALYSIS OF POST OPERATIVE RESULTS WITH DIFFERENT TYPES OF IOLS :-

Posterior chamber IOLS have been shown to give better postoperative visual results as compared to other types of IOLS . Kratz et al (1981) Compared Postoperative results with choyce mark VIII anterior chamber lenses, Binkhorst four loop Iris supported lens , Binkhorst two loop capsule supported lens and the shearing posterior chamber lenses . Although the percentage of patient with 20/40 vision or more was good for all type of lenses , a distinctly larger percentage of patients with posterior chamber IOL (60.8%) had visual acuity of 20/25 or better . In the FDA report on IOLS , STARK and Asssociates (1983) reported that 88% of patients implanted with posterior chamber IOL had a final visual acuity of 20/40 or more as compaired to 80.4% with iris fixated lens , 83.4% with anterior chamber lens and 86.5% with iridocapsular lens implants .

The incidence of various sight threating complication is lower with posterior chamber IOL implantation. Stark et al (1983) have reported that hyphema, secondary glaucoma, macular edema , pupillary block and late corneal edema developed in higher percentage of anterior chamber and iris fixated lenses than with poaterior chamber IOLS.These finding are consistent with those of Kratz et al (1981) ; these authors have also reported Subluxation of IOL to be more common in the iris supported and iridocapsular IOLS than in posterior chamber IOLs . Surgical problems where reported more frequently with anterior chamber IOLS [14% compared to 9% for the other types of IOLs Stark et al (1983)].

METHODS OF CAPSULECTOMY

Anterior capsutectomy is one of the most critical steps in extracapsular cataract exraction . Different types of capsulotomies have been described representative of widely practised methods mainly :

(1) **Envelope capsulotomy** (Liner,Intercapsular) horizontal slot is made which attains removal of lens substance and implantation of IOL as described by Galand A. (1983).

(2) **Capsulopuncture technique .** A punctuate openings smaller in size , joined togather to form a large opening.

(3) **Continuous curvilinear capsulorhexis** as described by Gimble HV and neuhan (1987) independently in which a smooth edged circular opening is made in the anterior capsule which is without any serrations it is made in a tearing manner of a bent cystostome or a Forceps.

The placement of the IOL in the posterior chamber mainly depends on the technique of the capsulotomy used , of all the capsulotomies most commanly used once are capsulopuncture techiques , which normally lead to placement of the IOL , mainly in the ciliary sulcus , but that also asymetrically .

The ciliary sulcus has been defined by Hoffer (1981) as the potential space between the iris root anterior and the ciliary processes and zonules posteriorly. The major arterial circle which lies in front the circular portion the ciliary muscle (Wolff) is in close relation to this potential space.

Most of the posterior chamber IOL implants after above mentioned capsulotomy methods are placed with at least one haptic in the ciliary sulcus, leading to asymetereial placement. Hansen et al (1988) in their study have found a high incidence of ciliary sulcus placement in eyes after postmortem studies, up to 49% of asymetreial placement and 18% sulcus/sulcus placement.

Similar studies only serve to high light the fact placing the loops of PCIOL is a blind procedure untill they are purposely placed in the capsular bag sheets (1984).

Jaffe has described a methods capsulectomy by making a D-shaped anterior capsulectomy by capsulopuncture methods. The credit for developing the endocapsular techque for placing IOL in the capsular bag goes to several individuals from the french speaking part of EUROPE most notably phillipe surdille and Georage baikoff apple DJ (1989) the easy visibility of the capsular flaps. With this technique makes it easier for the surgeon to place IOL within the capsular bag under direct vision, this method is fairly wide spread now with use of viscoelastie substances to ease it . The added advantage of the method is the ability of the anterior capsular flap to act as a protective shield for the corneal endothelium during various manuvers of cortical clean up and IOL insertion along with centration, since corneal endothelium does not come in direct contact with any intrument thus the protective efect Galland A.(1983).

Continous curvilinear capsulorhexis which was named after combining the three names given by 3 different sugeons who developed & perfected the technique, continuous tear capsulotomy by H. Gimble, capsulorhexis by Neuhan and circular capsulotomy by shimizu. Corydon (1991).

The combined term continous circular capsulorhexis was further modify to continous curvilinear capsulorhexis by Gimble.H.V. Neuhan .T (1991) (latter to editor) continous curvilinear capsulorhexis is a smooth edged circular opening in the anterior capsule with out serrations , Made by the tearing motion of a Forceps or a blunt cystostme this is becoming very popular because of its capability to reduce the propensity of radial tear formation and subsquent decentration . This further affects surgically induced Astigmation as induced by the tilting and decenration of the lens .

In this technique the capsular opening being smaller than the diameter of the nucleus the nucleus dilivery becomes difficult and the chances of the radial tears in anterior capsule are there theoratically but though rarely seen . Assia et al 1991 have proved in 50 humen cadaveric eyes by performing capsulorhexis of various size (2.5mm to 7.5 mm) and tried delivering the nucleus manully through them , they came to the conclusion that for each 1 mm of capsulotomy the capsule could be stretched for 0.6 mm more , thus the anterior capsule was torn when the circumference was stretched 1.6 times more than original diameter of capsulotomy or 5 times larger than the capsulotomy circumference , Assia et al 1991 have also proved that lens nucleus of profile circumfrence (sagital or anteroposterior) of 18 to 22 mm can be performed through a 5.5 mm opening .

Using a capsulectomy technique that creates a sharp edge or serration on the edge of the anterior capsule will cause a radial tear to occur was proved by Assia et al in an experimental syudy and the passage of the nucleus through the capsular opening is facilitated through this torn capsule .

A radial tear is defined a tear in the anterior capsule extending from the margin of ant capsulatory edge radially towards the equator . virtually all these tears Extend till at least 50% of distance of capsulotomy edge towards the eqautor . Wasserman (1991) A radial tear almost never extends beyond the equator towards the posterior capsule because of the supporting structure of zonules nevertheless the integrity of the capsule is lost .

Buddning & Rosen Refuted the Assia et al claims of elasticity of the lens capsule and attributed the stretching of a capsule as simple geometrical mathematical construct(Letter 1991) only to be disapproved by Assia et al where the author proved that the additional opening of the rim is attributed to the intact rim of the anterior capsulatory which was with out any weak points i.e.Jagged edges which could extend into radial tears Gimble and Neuhan (1990) Togather have discribed CCC for the first time and have emunerated various importent advantages of this technique over other capsulotomy techniques namilly **(a)**

implantation possible in children over two years of age. Since secure posterior chamber in the bag implants generally cause no problem during physical maturation. Gimble H.V. (1987)

Wasserman and associates (1991) have analysed in 250 operated eyes with IOL at postmortem examination for the presence and number of radial tears in anterior capsule. Over 90% of cases were of capsulopuncture type with 86% of eyes of these showing 1 to 5 radial tears, they further proposed that a more secure in the bag placement was most permanent achivement with only one or less tear in the anterior capsule and that the incidence of these tears was least in a CCC. Thus providing the scientific basis for moving toward and supporting transition toward CCC. They further concluded that C loop IOL was resistant to "pea podding" from the bag with a radial tear than J loop IOL, even if the radial tear did occur and also resist other decentring forces.

In two other seprate postmorten studies by Hansen et all (988) and Brems et all (1986) . It was proved that asymetrical fixation (one loop in the bag and other in the sulcus) is most common cause of decentration while IOL with symetrical Bag/Bag fixation had an average 0.4mm decentration while IOL sulcus/sulcus fixation 0.6mm decentration and the one with Bag/Bag fixation had 0.8mm average decentration .

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accidental intracapsular delivery risk of zonular rupture of fibres and vitreous loss has been described by Haris .

D.J. (1991) Allamallah O.F.(1989) . All these surgeons were using the conventional method of expressing the nucleus through the small circular opening thus leading to these above mentioned complications .

In another study the elastic property of the capsule was analysed . This study revealed that a capsule will rupture only after the circumference of the stretched opening is 5 times the diameter of capsulotomy , in this study of 6mm the rupture occured after stretching beyond 5 x 6 mm = 30 mm , and largest saggital or proffile circumference of a nucleus i.e. 8.5 mm in diameter and 4 mm in thickness is approximatelly 20 mm thus well in safety range for capsulorhexis rim to remain intact after nucleus delivery Assia et al (1991) .

Different instruments and techniques have been described by various surgeons to ease the capsulorhexis procedure and to ease delivery of nucleus from the capsule in to the Anterior chamber Corydon L.(1991) devised a surgical canula , Kershner (1989) a single forceps , and also a modified forceps by Corydon L. (1991) , Nishi O. (1990) described removal of nucleus out of the capsular bag by an irrigating capsule retractor, Thim K. et al (1991) described delivering the nucleus by hypro expression in thirty human cadaver eyes and the

capsule rim remained intact without any tear ; Shimizu K. (1988) described a double hook extraction technique by the hydro expression in with BSS Balanced salt solution was more gentle on the capsule & the zonules . Krag et al (1993) found the strength of posterior capsule till point of rupture , i.e. the hydro expression pressure needed for rupture of porteririor capsule was 59 mm Hg mean SD +/- 10 mm Hg , and also that to express the nucleus the average pressure needed was 13 mm Hg -18 mm Hg with capsulorhexis diameter is 5.5 mm or more . Thim K. et al (1993) disapproved with Krags finding according to them the pressure needed with hydro expression was 32 mm Hg for a smaller opening than 5.5.mm where he advocated using Healon i.e. Viscoexpression to deliver the nucleus and comparitively the capsular bag pressure was lower with Viscoexpression , thus proving Viscoexpression is safer and gentle in such cases for capsulotomies larger 5.5 mm they found that hyelroexpression was equally safe but not as gentle .

Maher J.F. (1988) suggested giving relaxing inscision in the anterior rim and then lifting the nucleus in the anterior chamber to ease its delivery but " the proceduere defies the whole idea of maintaining the intact anterior rim of capsule " according to ,Blumenthal M. (1990) , "changing the true bag to a false bag " Witteman(1989) suggested a use of larger capsulorhexis for nucleus expression of 7 to 8 mm size again to ease the nucleus delivery but it was found that opening of this

size was encroaching on the zonular insertion region anteriorly , thus it may lead to zonular disruption and associated complication Kozaki et al (1991) have shown that the refractive status of the eye with capsulorhexis and IOL implanted in the bag is relatively very stable and does not cause serious astigmatic error . Simillar studies have been done by Colvard et all (1990) Who mesured the decentration of the IOL in operated patient and found the fixation status stable .

Pande M. (1993) did one of the largest series of 210 eyes of CCC with planned extra capsular extraction . He analysed the complication with respect to incidence over time and concluded by the learning curve that . more complications occured during first few months of starting the procedure and gradually over the time the incidence of complications decresed thus proving that the complications were surgeon related rather than inherent defect of the procedure as technique . Leaming (1986) found that in a survey of various anterior capsulotomy techniques found that there is a clear cut in trend of surgeons doing CCC from 1% of surgeons in 1985 to 29% in 1986 , and proggesive increase in the number of surgeons doing capsulorhexis as the procedure of choice , is proved by Leaming (1992) . Who suggest that continuous tear capsulotomy is the procedure of choice amongst 80% of members of American society of catract and refrective surgery .

COMPLICATION OF POSTERIOR CHAMBER LENS (PCL) :

The PCL implantations are now regarded as the most successful intraocular surgery Jaffe (1986) , still complication do occur and among the most common complication seen are : Apple D.J. (1984) .

1. Lens malposition - decentration and dislocation . and different types of loops fixation problems.
2. Inflamation and its sequelae : corneal decompensation , cystoid macular edema .
3. Opacification of media .
4. Faulty fixation of loops and related problems .
5. Postoperative astigmatism .

COMPLICATION OF LENS IMPLANT POSITION

As younger patients with larger and more mobile pupils receive more IOL implants better centration assumes increassed importance since these are the patient whose pupils dilate widely expecially in dim illuminates and these are the patients who are still occupationally active Brems et all (1986) have determined ,that various optical components such as positioniong holes, optical edges within the pupillary margins may causes visual aberrations most commonly with decentration optics. Clinically decentration is defined as the visibility of the edge of the optic in the undilated pupil. Apple D.J. (1984).

Sunset syndrome refer to the inferior subluxation of IOL so that superior edge of the optic becomes visible in pupillary zone , in a study of thousand eyes . Kratz (1979) reported 0.4 % subluxation but no sunset syndrome ." Windshield Wiper Syndrome " occurs when PCIOL is poorly fitted or fixed , in this case the implant moves from side to side and causes diplopia or annoying varying vision . Various studies have concluded that total loop diameter , optic size had no apprent effect in IOL centration in the immediate post operative period whereas the location of the IOL fixation proved to be most significant factor specially in asymetric fixation decentration was found to be significantly higher by Apple (1984) , Brem (1986) , Hanson(1986).

Least decentration was seen in B/B fixation on radial tears (i.e. Intact CCC). Regardless of IOL size & style but in anterior capsulotomy with radial tear the Decentration was significially higer Ledger et all (1992) due to "pea podding" i.e. when even when both the loop are in capsular bag due to a radial tear in the capsule uneven forces act on the IOL and thus may cause a loop to excape in suclus and result in B/S fixation eventually ocour and result in decentration . The decentration degree is propotional to the number of tears in the capsule ledger et all (1992) .

Asia et all (1991) in their study have stated that in all types of capsulectomy i.e. , liner capsulopuncture

there was 100% tear formation in Ant . capsule after lens delivery where as in capsulorhexis it was 0% with same average nucleus thickness 4 Diameter .

Mainly sugeons also have enumerated following causes of decentration which may be early or late :

1. Escape of a loop initially placed in the capsular sac , either intraoperatively , during rotation manoeuvre or dialling of the IOL of postoperatively because of too large anterior capsulotomy that those not leave enough capsular flap to hold the lens in place ("pea pod effect") or escape of the loop from the one the radial tears in the anterior capsular rim .

2. Pupillary capture

3. Distortion of a loop during insertion - most likely with three piece IOL with polypropylene loop

4. Uneven pressure or traction by proliferating residual lens epithelial cells and their derivatives due to fibrous or myoepithelial metapasia , excerbated by contracture with irragulers anterior capsulatomy may cause unevern force and cause late decentration .

According to Mazzocco (1987) , chances for later decentration of an implant is more with capsular bag fixation . However, Hansen and his associates (1988)

did not find any statiscally signification relation between decentration and duration or style of lens .

Several studies define the numerous advantages of capsule fixation . Johnson S.H. (1984) Apple D.J. et all (1984) particularly in term of avoiding the uveal contact in order to minimize such potential as low grade inflammation or uveitis at or near the loop sites . In the series by Mcdonnel et all (1987). 120 eyes of autopsy cases , 95% had one both loop in the uveal region . 13% of these cases had iritis . 24% cyclitis , and 44% had demostrated a granualomatouse reaction to the IOL loops other previously documented problems both short long term include posterior iris chaffing(erosion) sundrome with microhyphaema pigmentary dispersion syndorme and possible adverse reaction to the loop biomaerial .

The ciliary body is softer in consistency because of its vascular nature . Intraoperative or postopertive migration or crossing of one or both loops in an uveal fixation IOL in to the ciliary stroma or muscle can occur . Miyake et all (1984,1988) hve proved that the long term recovery of B.A.B. is delayed in the sulcus fixation posterior chamber IOL in compared to the "in the bag placement by fluorophotometric method".

ADVANTAGES OF IN - THE - BAG PLACEMENT OF IOLS

The conecpt of placing an IOL in the capsular bag has more then an aesthetic appeal . When the loops are placed with in the capsular bag, they become well encapsulated within the sac. Thus the lens loops are firmly held in position by proliferation of cellular meterial within the capsular sac (sheets) However Olson (1979) expressed the view that the fact that loops were inserted in ciliary body sulcus with some pressure was an advantage , in that, it gave the lens a frim fixation which does not require further synechine formation. several advantages of "in - the - bag" placement of IOL have been described in the literature.

1. Centration:

A common postoperative complication following an extracapsular cataract extraction with posterior chamber IOL implantation is optic decentration (Hansen et al 1988) . The site of fixation of loops of the IOL have been shown to have an important bearing on this problem . During intended ciliary sulcus fixation , the insertion of second loop often causes the first loop to become firmly implanted in the ciliary body sulcus thus dencetering the IOL towards the first loops Olson (1979). Asymetrical fixation of IOL loops has also been shown to be consisently associated with 1to2mm decentration of the optic McDonell et al (1987). Hanses

et al (1988) have reported a decentration of 0.8 mm or more in 60% of the asymmetrically fixated IOLS .

A study of posterior chamber IOL implantation in the capsular bag in 284 patients by Rochels (1988) has shown excellent centration in 87% cases , minimal displacement (lessthen 0.4 mm) in 12% cases and gross decentration of IOL within capsular bag was seen in only 1% cases.

2. Blood aqueous barrier studies :

The accumulation of fluorescein in the anterior chamber following systemic administration has been used as a sensitive indicator of the effectiveness of Blood aqueous barrier (cunha,1979) (Sanders 1982). Cataract extraction is associated with a transient disruption of the barrier which soon returns to its normal state as compared to the follw eye kraff , (1980) sanders 1982,1983). Kraft (1980) has shown that 22% more fluorescein appeared in the anterior chamber of operate eyes then in control eyes. Six month after surgury the flourescin concentration was only (12%) greater in the operated eye. Liesegang (1984) has reported no statistical difference in the Blood- aqueous barrier in patients following exaracapuar cataract extracapular cataract extraction with IOL implantation as compard to the fellow eye one to two years after surgery . Miyake et al (1984) studied the influence of various IOL fixation sites on the blood-aqueous barrier in 106 eyes using slit

-lamp fluorophotometry They found a more severe disruption of the barrier in eyes with posterior chamber leneses fixation in the ciliary sulcus then in those with intracapular fixation .

3. Effects observed on histopathological sudies :

Several histopathological studies have been reported on eyes implant with an IOL fixation in the cillairy sulcus. The sulcus fixated loops show erosion and non-inflammatory migration into the peripheral iris as proved by Olson (1980); loops have been found totally embedded in the ciliary body in 30% eyes by McDonnell et al (1987); these authors also found one haptic having totally eroded through the ciliary body and lying in the supraciliary space. Erosion through ciliary epithelium has also been reported by Irvine (1981) and Bleckmann et al (1985).

The sulcus fixated IOLs , having eroded into the ciliary body come to lie close to the major arterial circle. A focal absence of the arterial circle was found in 11% cases , along with a recent thrombus of major arterial circle adjacent to site of erosion of loop in to the ciliary body (McDonnell, 1987) .

These observation have led Olson et al (1980) Irvine (1981) and McDommell et al (1987) to conclude that erosion of uveal tissue may help stabilize the IOL

put at the expense of greater likelihood of introcular inflammation and haemmorhage .

Apple and co-workers (1984) observed one case where deep erosion of sulcus fixated J- loop posterior chamber IOL into the ciliary body led to anterior segment ischemia and subsequent development of rubeosis and neovascular glaucoma which eventually required enucleation of eye involved .

4. Posterior capsule opacificaton (PCO)

An important long term complication of extracapular cataract extraction with or without IOL implantation , is posterior capsule opacifiation (obstbaum , 1987) the incidence of which has been found to approach 50% in some series three to five years postoperatively (Sinskey , 1978; Lindstrom , 1980). Pathologic examnation indicates that the lens epithelial cells usually responsible for PCO are those attached to anterior capsule Hiles, (1980) McDonnell , (1983) Therefore , a smaller anterior capsulectomy , as with the endocapsular technique , might result in a higher rate of delayed PCO . However Nishi (1986) observed that fewer lens loops were present "in -the - bag" in eyes with PCO than in eyes that did not develop PCO after lens implantation .

A taut capsular bag , best achieved with single piece IOL Desigh placed 'in-the-bag' resulted in a

lower PCO score Hansen so , (1988) . The experimental work of Manfred and co-workers (1988) with the circular disc IOL placed 'in-the-bag' provides additional evidence that the barrier effect is best achieved with a gentle , taut radial strectch on the capsular sac .

4. OTHER ADVANTAGES :

Hayasaka and associates (1982) have demonstrated that the activity of the lysosomal enzymes is highest in the ciliary body and lowest in the lens , which suggest thast loops inside the capsular may be protected from biological degradration by lysosomal enzymes .

In his study on living postopretive eyes , Miyake (1984) has reported that haptics , when properly placed in the bag were sandwiched firmly in the capsular envolope . Residual lens remnants played a bioadhesive role , both between the two capsules . Thus he has concluded that properly positioned capsular fixation may be safe and firm.

Alpar (1985) has reported that the development of new or the worsering of old diabetic and retinal change , as well as cystoid macular edama , were much less if the IOL was implanted in the capsular bag than if the IOL was fixated in the ciliary sulcus .

IOL DECENTRATION :

A common postoperative complication following extracapsular cataract extraction with posterior chamber IOL implantation is optic decentration (Hansen et al 1988) .

CAUSES :

An important cause of decentratioin of the IOL is assymentrical fixation of loops of the lens as shown by McDonnell et al (1987) and Hansen et al (1988) . Legler et al (1992) studied various factors in intraocular lens decentration i.e. IOL dimension , design , style loop fixation and anterior capsular tears in experimental model of post mortom human eyes .

The posterior chamber of various designes style with loop diameter between 12mm to 14mm and after diameter 5.0mm and 7.0mm with symetrical & asymetrical fixation were studied . The decentration was less with capsulorhexies i.e. bag/bag placement and no radial tear of posterior capsule mean D . 20 +/- 0.05mm , asymetrical bag/sulcus fixation in presence of anterior capsular tear was highest in decentration rate (Mean : 68 + / -2 .8mm) .

Assia et al (pth 1991) . Studied the mechanism of radial tear formation in postmortem eyes with various techniques of capsulotomy and also studied the

mechanism of extension of the radial tears by using modified calipers to exert a tearing force . They proposed that in capsulorpuncture technique or similar techniques duing the delivery of the nucleus or even duing IOL insertion considrable force is extrted on the margin of the capsulotomy "Arrow Heads" pointing radially the periphery and pressure at the capsulatory margins often extends these tears this may lead to late escape of the IOL loop out of the bag when the capsule contracts ("pea podding") thus resulting in decentration.

In envelop technique the corneal endothelium is protected but to remove a nucleus 8mm in diameter and 3.5 to 4mm thick in center the tear in the anterior capsule must reach the equator. The anterior capsule is cut and torn after the IOL is implanted however , the capsulatory margin is fully continuous and smooth

Much stronger forces is needed to creat a new tear than extend the pre-existing and i.e. capsular hexis is much less prone to radial tearing than other techniques . When there is a serration or tear the molecules tear at edges . Thus the whole tearing force will become concentrated at a point .Thus a much lesser force is required to exceed the intermolecular forces . The integrity of the margin of the capsulorhexis is maintained as long as the molecules at the out margin remain intact as a continuous chain proposed by Assia et al (1991) .

Other important causes of optic decentration are prolifration of residual cortex , assymetric shrinkage of capsular bag and perforation of the capsular bag of lens loop (Rochels , 1988) .

Delayed subluxation of an IOL is probably most frequently caused by trauma to the eye (Murphy , 1983).

CLINICAL SIGNIFICANCE :

Undesirable visual complication such as glare , halo monocular diplopia or other visual aberration can result from the presence of posterior chamber lens optic edges , positioning holes or loop optic junction within the pupillary aperature . In a series of 75 autopsy eyes with posterior chamber IOL Brems et al (1986) have observed that in 71.1 of cases on optic edge as on element of optic such as the postioning hole , was selvoled either within pupillary apperture (average pupillary diameter 3.45mm) or within 0.5mm of pupillary margins this finding was most common (92%in cases with asymetric placement of IOL and less common (50%) with symetric placement .

INFLAMATION

Intraocular microsurgery is essentially a trauma to the eye and is associated with a series of change that are related to the surgical trauma. Inflammation is the natural tissue response to it. The severity of tissue

damage and alteration of blood - aqueous - barrier (BAB) are responsible for haziness of the media, capsular opacification , synechia , pupillary change and raised introcular pressure apple D J (1984). Significant increase in inflammatory response occurs with the increase in duration of surgery .

Incidence of early postoperative inflammation range from 0.3 -3.3% with modern generation IOLS Apple DJ (1984). According to first postoperative year . Any inflammation that affect the anterior segment of the eye lead a transient or permanent breakdown of BAB liesgany (1984) . Trasient uveities after cataract surgery is therefore , no surprising .

BAB which consist of edothelium of iris blood vessels and nonpigmented ciliary epithelium , is susceptile to surgical trauma . There are basically two mathodologies to evaluated the ocular inflammation response , namely by studing the alteration of BAB by flurophotometry and particle counting using laser flare cell meter. Fergusson and Spalton (1991) have sown that eyes with uncomplicated surgery BAB recovered rapidly during first 6 weeks and by 3 months in most of the patients. According to sanders (1982) et al. the BAB is restablished by 3 month after uncomplicated surgery and postoperative subconjumctival and topical steriod. Sawa et al (1984) used an index of BAB function in the early postoperative period (6 days after surgery)

and found that PCL does not increase the breakdown of BAB in comparison to ECCE without any implant.

These result suggests that in normal eyes with uncomplicated surgery, recovery of the BAB in the early postoperatve period is not influenced by the either the presence or absence of an implant on its position . The changes in the BAB reflect a normal healing and recovery process in the iris and ciliary body. Miyake et al (1984) found more leakage with sulcus fixation of PCL then those with "in-the-bag" fixation on an average follow up of the year, However, after a longer follow up for three years, there was no difference in the leakage between aphakic eyes and those with in the bag or sulcus implant.these result imply that an advantage of capsular bag to sulcus fixation is the prevention of the uveal chafing or erosing which becomes obvious only on medium to long term followup. Miyake and his co-authors (1988) observed that indomethacin has a beneficial action but has less influence in long term.

Mc Donnels et all in their study in post morterm eyes found,
That the errrosion caused to the ciliary body was related to the site of the implant and the density of the hapties rather than the surgical placement.

PSEUDOPHKIC INFLAMMATION :

Intraocular lenses are fabricated of various biomaterials which like other biomaterials implant elsewhere in the body may elicit such responses as inflammation and fibrosis.

Most IOL loops are made up of polyprohylene (prolene) or polymethylmethacrylate (PMMA). Several authors have found (Gallin 1982) Goble (1987) that prolene can activate complement by alternate pathway. Activate of agent for polymorphonuclear neutrophils (PMN) may result in influx of PMNs into the tissues surrounding the implant . So surgeons feel that prolene loops can increase ocular inflammation. But Apple and co-authors (1984) have not observed any evidence that prolene has direct tissue toxicity more than other polymers . PMMA dose not activate compliment directly (Goble 1987) Instead it acts as a support for an immunoglobulin rich coating that in turn induces chemotaxis.

MECHNICAL FACTORS:

In the earlier years of PCL implantation . when ciliary fixation was the rule polypropylene was the prefrred loop material . Because it was believed to provide a more gentle touch within the ciliary region due to greater flexibility (Apple D J 1984) . When morden PCL prototypes were intoduced in 1977-1982 , only a

few IOLs were manufactured with PMMA loops. Generally it was thought that the more rigid PMMA loops exerted greater pressure into the ciliary body structure causing deeper erosion into uveal stroma . With the increasing trend towards capsular sac implantation loop-polymer memory retention has become desirable because the lens capsule can be returned to its original shape . Lenses with C-loops provide the optimal comformation to the circular shape of the caplular sac . Once the lens is inserted it is advantageous for the loops to exert a gentle pressure along the arc of equatoriol margin . Stretching the posterior capsule evenly across the back surface of the IOL optic.

TOXIC LENS SYNDROME:

This term was originally used to denote a sterile postoperative inflammation following IOL implantation and often associated with hypopeon or vitreous reaction (Hunter 1987). Direct ocular toxicity caused by residual polishing agents on IOL surface wet pack

sterilisation or the early drypack sterilisation are some different causes of this syndrome (Meltzer 1980) .

ANTERIOR SEGMENT ISCHEMIA: is an uncommon IOL related cause of inflammation . Apple and coauthors reported a case of anterior segment

ischemia that resulted from deep erosion of the lens loop into the iridociliary sulcus with partial bisection of vascular plexus within the ciliary muscle Apple DJ (1984) .

BIODEGRADATION:

Surface fissures or cracks may appear on the loop due to superficial oxidation or change in crystallinity of the outer surface of the polymer . These are superficial and represent no more than 1-2% of loop diameter . This appear to be time related process and approximately takes 2 or more years to occur.

UVEAL COMPLICATIONS

IRIS DISTURBANCES:

The iris which makes up the most anterior portion of the uveal tract is highly vascularised tissue and prone to inflamation when irritated . It has long been recognised that the more an IOL rubs against iris , the greater is the risk for subsequent inflammation Iris or errosion chafing leads to BAB breakdown and release of inflammatory mediators (Miyake 1984) . The lens capsular sac is the fixation site that isolate a PCIOL from the uveal tissue (Apple D J 1984) whereas sulcus fixation can cause iris stroma thinning and/or loss of iris pigment epithelium .

"Microhyphema syndrom" or "Visual white out" is another sequelae to iris chafing . Liepman (1982) who coined the term white out syndrom was able to control the bleeding in some eyes by immobilising the iris with miosis or mydriasis . He attributed the bleeding to friction between the lens and vulnerrable capillaries at the pupil .Since iris motion tends to decrease with age , microhyphema syndrome would be expected more in younger patients . Recrrent microhyphema has also been reported by Jonson and associates (1984) .

Pigment dispersion is another complication of iris chafing (Ballan 1982) . Mechanical chafing by component of an IOL against the posterior iris pigment epithelium is attributed as the cause of this psedophakic pigment dispersion syndrome .

POSTERIOR SYNECHIA:

Clinically significant posterior synechia formation between the iris and PCL or iris and anterior capsular flap is much less likely to occur though it has been observed by several author (McEntyre 1985) . In the intercapsular cataract surgery posterior synechia frequantly occur between iris and the anterior capsular remnants and characteristically located at 4 and 8 o 'clock position as the anterior capsular margin remain everted here (Raines 1989) . In case of sulcus fixation IOLs , posterior synechia occur mainly superiorly due to surgical trauma (Leipman 1982) . Visual outcome,

however remain unaffected but it can cause cosmetically unacceptable pupil and limit pupillary dilatation making posterior segment surgery more difficult.

DISTORTED PUPIL:

PCLs can sometimes cause pupillary distorted like peaking which may occur secondary to direct contact of a loop on iris root causing iris tuck. Other causes of pupillary anomalies may be postoperative inflammation or iris into the wound. Capsular sac fixation may minimise such problems.

Oval deformation of pupil , like that with anterior chamber IOLs occur in 25% cases usally 6 weeks after sugery. This is progressive and may cause glare. Long axis of the IOL is observed to lie along the oval pupil which may indicate the possibility of mechanical stretching as aetiology.

PUPILLARY CAPTURE:

An uncommon complication which was commonly seen with rigid J-Loop which vaulted anteriorly (approximately 2.6%) (Apple D J 1984) . With the introduction of 10 degree posterior angulation by Kratz (1981) , the incidance has decreased to 1.4% . However , Lavin and Jagger reported 3.1% incidance of pupil capture. They observed that early capture result from mechanical factors and usually preventable whereas the

late capture is of synechial origin (Lavin 1986) , rarely mechanical in nature. It is rare with in the bag implantation .

PUPILLARY FIBRIN MEMBRANE:

High incidence (4.4%) is reported with Japaneese population whereas 1% is the incidence seen in western population . They suggested several aetiological factor e.g. dry sterilisation immature cataract with incomplete cortical clean up, systemic hypertention etc. And may have immunological basis , but according to Nishi 0 (1988) it is basically a foreign body reaction . he postulated proliferation of traumatised epithelial cells at the capsulotomy margin.

POSTERRIOR CAPSULAR OPASIFICATION (POS):

PCO is one of the most common complication of current cataract surgery (Apple D J 1984) , the incidence of which is difficult to state with certinity because the literature present a wide range of data often representing the use of particular surgical technique , lens design and method of implantation (Frezotti 1990). Sterling and wood (1986) reported 18.4 to 50% incidence of late onset PCO after ECCE with PCIOL in patients followed up for 3-5 years . Some other authors also reported similar results (Mc Donnell 1983) . The interval between surgery and the appearence of PCO varies widely .

According to Mc Donnell and co-authors (1987) upto 50% of all adults may developed a secondary membrance within 5 years pstoperatively . Wilhelmus and Emery (1980) average opacification time of 26 months after surgery with a range from 3 months to 4 years . There is an age related tendancy towards membrane formation with nearly 100% of paediatrics patients developing capsular clouding within two years of surgery and the rate may drop below 10% in patients over 70 years age Frezzotti and Caporiossi reported 11.02% incidence rate for modified J loop lenses and 7.35 % with modified C loop lenses in their study that complete cataracts (mature) had significantly lower tendency to produce postoperative capsular opacification than other cataracts type (nuclear , cortical , suncasular) .

The posterior capsule itself does not opacify but merely act as scaffolding for the growth of a secondary opaque memrane following cellular proliferation the primary source being controversial . Mild early postorerative translucence of posterior capsule (PC) may occur due to deposition of fibrin , inflammatory cells and lens epithelial cells . This type of haze is more common with in the bag fixation of an IOL . The most commonest cause of PCO relates to the proliferation and migration of retained lens epithilial cells and its derivatives into the visual axis

(MC Donall 1983 , Willhelmus 1980) . Different process that contribute to PCO are the formation of metaplastic fibours tissue . The different cells responsible for PCO primarily arise from three source . First , is the anterior subcapsular cuboidal cells which transfrom onto fibrous cells , being released from contact inhibition by anterior capsulotomy . They proliferate slowly towards the equator and peel off from the capsule to form second type of cells which develop into the equatorial lens bowe and grow along the posterior capsule. Residual cortical fibers from the equatorial lens bowe that become disilodged and float freely within the capsule are the third soruce of lens material . They undergo pseudofibrous metaplasia with time. According to M C Donnell and co-authors (1983) , PCO occurs due to proliferation of anterior lens epithelium on the PC and proliferation starts from the site of adherence of anterior capsular flap with the P.C. Thus a wide anterior capsulotomy may be helpful to reduce the risk of PCO . However , Apple et al (1984) do not agreee . According to them , the origion of PCO are the cells from lens equatorial bowe.

CLINICAL TYPE OF PCO

1. **Haze:** Due to celllular migration . Visual deprivation occurs only when it become multilayered .

2. **Wrinkling:** Due to contraction of myofinbroblast like cells .

3. **Elsching ' s Pearls .**

4. **Fibrosis:** Seen as dense white opacification .

CLINICAL FEATURES OF PCO

1. Intrinsic factors related to the capsule:

(a) Proliferation and enlargment of the residual cells of anterior subcapsular epithelium (glass and , elschnig ' s pearl) .

(b) Fibrosis , likely metaplastic .
(c) Fine folds
(d) Mixed

2. Intrinsic form not related to the capsule and the parenchyma:

(a) Remains of Lenticular fiberes (Sommering ' s ring) .

3. Extrinsic form unrelated to Lens :

a) Pigment dispersion

b) Exuadative fibrosis and /or haemorrhage

DEVELOPMENT OF PCO :

It develops in 3 ways (Martin 1990) . Firstly , an early fibrous fraction occurs with in first year often as a result of per or post operative complications . Secondly , after first postoperative year , Lens epithelial proliferation may give rise to in growth of Elschnig's pearl . Thirdly , a diffuse fibrosis reaction is observed .

FACTORS AFFECTING PCO :

1. **Anterior capsulotomy :** A large anterior capsulotomy may reduce the risk of PCO (Freman J 1978) . But according to Apple et al (Apple D J 1985) this is not as the migrating epithelial cells originate in the lens bow zone . Continuous circular capsulorhexis by Neuhann may help to reduce PCO (Neuhann 1987) . Gible (1990) proposed reduced incidence of PCO with CCC by the fact " With strong regular opening , the capsule is strong enough to allow extensive vaccuming of Lens epithelial cells and when most there are removed , there is significant reduction of pearl formation and PCO .

2 . **Removal of anterior capsule :** Removal of anterior subcapsular epithelial cells by using ultrasound tip (Nishi O 1987) , Scratcher with bullous tip (Murata 1985) and by other methods cytostatic and cytotoxic agents : (Apple D J) , may revived the concept of careful removal of anterior capsular epithelium by

which the anterior capsule will remain staisfactorily clear .

3 . **Tightening of PC** (Petter C D 1990) : Posteror capsule (PC) in case of in-the-bag PCIOL tightens and narrow the space between the back surface of the optic and PC within fibrous tissue causing this tightening originates from metamorphosing residual lens or iris pigment epithelial cells and melanocytes left in the capsular bag.This tightening may play a beneficial role by eliminating PC wrinkles.

IOL DESIGN AND PCO:

Role of PMMA: It is accepted that the presence of IOL in the posterior chamber can significantly reduce the incidence of PCO (Nishi o 1986). Close contact of the optic might inhibit epithelial proliferation ("no space, no cell", as suggested by Santos et al: 1986). But this might also contribute to fibrosis of the PC by inducing metaplastic differentiation of residual epithelium into Myofibroblast.

IOL DESIGN:

Highest PCO score (Hansen S O 1983) was observed with nonangulated planoposterior and lowest with biconvex and posterior convex 10 degree angulated lenses. Tautness of the posterior capsule is also a contributing factor to PCO score. Single piece lenses

had a lower score (Henson S O 1988) because after implantation PMMA loops resumed their original shape and expanded the PC radially. Asymmetrically stretched PC appears to be critical for minimising contact between PC and the optic , regardless of the optic design. In contrast, PCO was more with prolene loops which can be explained by the fact that they do not reexpand sufficiently to provide the taut sketch necessary for maintaining the contact between PC and the IOL optic.

An intact anterior capsular rim i.e. as in CCC will position the IOL more posteriorly because of the resistance that the angulated optics exert. The angulated haptics of one piece PMMA lens tend to push the optic further keeping the posterior capsule taut against IOL surface (Gimble 1990).

CORNEAL COMPLICATIONS

The corneal complications of cataract surgery are primarily related to the damage of the endothelial cell layer causing lower cell counts leading to cornеal edema and decompensation (Bourne 1976). Such stress is probably most determinal in eyes with preexisting corneal diseaes and intially low cell counts. The relativity vulnarable posterior surface of corneal endothelium makes it

susceptible to injury during cataract surgery and its recovery to normal function is limited by poor regenerative capacity.

Both qualitatively appearence and quantitative count of endothelial cell are important in determining the post operative outcome (Rao G N 1984) the latter being highly predictive. Corneas with uniform endothelium tend to do well even with a low overall cell count whereas endothelium showing marked variation and abnormality in size and shape ("polymegathism") is much more likely to decompensate post operatively. This view is supported by other authors also (Glasser D B 1985).

Average endothelial cell loss in ECCE with PCOIOL implantation is 11.6%. (Karff M C 1982) which is less then that reported with other types of IOLS, Matsuda (1988) reported a cell loss of 23.5% marked polymegathism and pleormorphism of cell in ACIOL Intact posterior capsule the incidence of pseudiphakic bullus keratopthy with modern PCLS is started to be in the range of 1-2% (Taylor 1983). Some authors observed 16% cell loss with no apparent intraoperative trauma which increased upto 67% with PCLS. Post surgical trauma and or late indirect endothelial damage by inflammation or pre existing endothelial diseases.

Kaufman and Katz (1976) observed that contact between the IOL surface and endothelium often result in adhesion and subsequent strippeing of endothelial cells from Descemet's membrane.

Use of intracapsular and similar small incision capsulotomy techniques that confines the dynamic force of cortex removel within an almost intact capsular sac, appear to minimise endothelium damage. Different experimental and clinical studies confirm this hypothesis (Solomon K et al 1988).

Strriping of Descemet's membrane is another intraoperative cause of endothelial cells loss (Drews 1978). Late indirect endothelial damage can only be explained by assuming a direct toxic effect of mediators derived from foci of chronic smoldering inflammation, either clinical or subclinical (Obstbaum 1979). Such inflammation is usually present at the hapic fixation sites in the ciliary region . Inflamatory mediators like prostaglandins are know to be toxic to endothelium. Moreover, oxidative radicals formed by neutrophils and other inflammatory cells may be toxic to the endothelial cells (1984).

CORNEAL THICKNESS:

Functional impairment of the corneal endothelium can be judged from the measurement of corneal thickness (Leite 1990). However, the alteration of

endothelium can be present long before it is manifested by incresed cormeal thickness and pachymetry is therefore, a useful but relatively insensitive technique.

Specular microscopy and flurorophotometry are better methods for endothelial functional assesment (Lei te 1990). After uneventful surgery, the endothelial cell density rapidly decreases along with and increase in cormeal thickness within the first month, morphological changes. Subsequntly the rate of the cell loss decreases between 3-6 months post operatively the pattern returns to normal (Matsuda 1984). Hence an increased corneal thickness suggest recent cell loss, while a decreased cell density along with an increased mean cell area suggest a past history of endothelium cell loss and corneal thickness has variable reports.

CORREALATION OF CORNEAL THICKNESS AND ENDOTHELIAL CELL LOSS

Abnormalities in endothelial function are correlated with changes in corneal thickness , then one variable and cannot be expected to be an exact measure of the amount of irreparable damage done to the cornea, any cell damage leads to delay in recovery of normal thickness. Cheng et al (1988) have studied the correlation between the endothelial cell loss and corneal thickness in the early post-operative period using a Haag- Stereit pachemeter (Mishima, 1968) and non contact specular microscopy. Cell loss of 30% or more were found to

have significantly greater change in corneal thickness at 48 hour and five days .

Busacca before sutures were employed . The degree of astigmatism was to be reduced if sutures were used (Green holm) . Floyd (1950) noted that the degree and axis of astigmatism changed rapidly over the first four post operative weeks and more slowly for a further three month . Iltiff (1967) suggested that post-operative astigmatism could be controlled by careful wound apposition and suturing . Jaffe and Clayman (1975) applied the method of vector analysis and rectangular co-ordinates to quantify the true surgically induced astigmatism . In this classic paper they analyzed a variety of suture materials and techniques of incision and closure and their effect on the surgically induced astigmatism .

CLINICAL PROBLEMS WITH ASTIGMATISM :

Astigmatism results in a number of clinical problems for patients even with properly refracted glasses (Terry). Minus lenses make objects appear smaller and plus lenses make objects appear larger. With astigmatism , the patient does not get a uniform minification or magnifications ; instead he gets an elongation in one direction and a shortening in the other. So, the objects may appear tall or squat or tilted. All these aberrations are compounded in elderly patients who undergo a cataract surgery.

FACTORS AFFCTING SURGICALLY INDUCED ASTIGMATISN

Bartholomew (1988) has defined two factors responsible for the surgically induced astigmatism: Wound gape and wound compression. Would gape occurs in absence of suture . intended or unintended removel of sutures and in conditions leading to delayed would healing . wound compression is produced by a combination of tight , non-absorbable sutures and post-operative wound swelling or edema . The degree of corneal change induced by gape or compression is influenced by the size , position and type of incision .

1. SIZE OF INCISION

A small wound does not tend to gape because of the lateral support that it enjoys the intact limbus . In addition there is less tendency to overtighten sutures in a small wound than in a large wound . With larger incision there is greater likelihood of the cornea being distorted from its original shape . In their study on the human cadaver eyes . Flaharty and associates (1989) have reported that large incision group had twice as much astigmatic change as the small incision group .

Reading (1984) has reported a smaller variation in the mean radial of curvature in patient undergoing phacoemulsification though a small incision as compound to patients undergoing intracapsular cataract

extraction by a lage incision . he has concluded that with a smaller incision , a single suture and minimal tissue handling , the resultent changes in cormeal curvature were reduced .

2. PLACEMENT OF THE INCISION

The further incision is from the corneal optical zone , the lesser the surgically induced astigmatism . Flaharty (1988) reports a 7.9 times more astigmatic change with limbal incision than with a scleral flap incision .

3. PLACEMENT OF SUTURES

Deep inserted sutures with wider bites cause a greater wound compression and a higher 'with- the- rule' astigmatism in the post-operative period. In their study on 1557 eyes joffe and clayman (1875) found that placing 10-0 monofilament nylon sutures more superfically in a more posteriorly situated incision gave a with-against ratio of 1:1 Moving the incision closer to cornea and placing the surures more deeply changed this ratio to 4:1.

4. TIGHTNESS OF SUTURES

Lighter the sutures, greater the wound compression and consequently a greater suture

induced astigmatism. Flaharty and co-workers (1989) have studied the effect of suture tension on early postoperative corneal astigmatism in human cadaver eyes. The surgically induced astigmatism was calculated using the rectangular cordinate method (Jafe and Clayman, 1975). The authors defined the principal meridian as the calculated vector of induced astigmatism. It was considered to represent 'with-the- rule' astigmatism if the vector fell between 70 and 110 degrees, against - the-rule astigmatism if the vector was within 20 degrees of the 180 degree meridian and oblique astigmatism if the vector fell anywhere in between. In the tight suture group the astigmatism was with-the- rule 69% times and oblique in 31% cases. The loose suture group produced against the rule astigmatism 44% times, oblique 38% of the times and with-the-rule in only 18% of cases. The high percentage of against the rule astigmatism in the loose suture group has been explained on the basis of wound gaping inherent to this group which leads to flattening in the meridian perpendicular to the incision (Van Rij and Waring 1984).

ASTIGATISM IN CATARACT SURGERY

HITORICAL ASPECT:

It is generally reported that corneal astigatism is with-the-rule in young eyes and that there is a shift towards against-the-rule astigatism with advncing age (Duke Elder) .

Donders (1984) first showed that unwelcome consequence of cataract surgery in an alteration in corneal curvature resulting in surgically induced astigmatism . The true change in the corneal cuvature was measured by sequential keratometry in 1932 by Busacca before sutures were employes . The degree of astigatism was to be reduced if sutures were used (Groenholm) . Eloyd(1950) noted that the degree and axis of astigmatism changed rapidly over the first four month . Illiff(1967) suggested that post-operative astigmatism could be controlled by careful wound apposition and suturing . Jaffe and clayman (1975) appplied the method of vector analysis and rectangular co-ordinates to quantify the true sugically induced astigmatism . In this classic paper they analyzed a variety of suture materials and techniques of incision and closure and their effect on the surgically incduced astigmatism .

CLINICAL PROBLEMS WITH ASTIGMATISM

Astigmatism result in a number of clinical problems for patients even with properly refracted glasses(Terrry) . Minus lenses make objects appear smaller and plus lenses make objects appear larger . With astigmatism , the patient does not get a uniform mimification or magnification ; instead he gets an elongation in one direction and a shortening in the other . So , the object may apppear tall ,or squat or tilted .

METERIAL METHOD

MATERIAL & METHOD

This study was a comparative clinical study of surgical procedures of Capsulorhexis, linear capsulotomy and capsolupuncture technique with planned extracapsular extraction with PCIOL implantation.Of all the patient attending MLB Medical College with Cataract, 60 eyes with Immature Senile Cataract were studied, eyes with good fundus glow after mydriasis were included in study group of capsulorhexis cases. Eyes with hypermature, mature, complicated, pathalogical cataract or eyes with any other associated pathology i.e. of anterior segment, i.e. uveitis, glaucoma subluxated lens were excluded and similarly any pathology of the post segment, were also excluded i.e. retinal detachments, vireous opacities, maculopathies etc.

PREOPERATIVE ASSESSMENT : Included type of cataract, relevant history, examination. All the patients with hypertension or diabeties were controlled before being taken up for surgery.

The study group was being divided into three sub groups.

Group " A " 20 eyes with (capsulopuncture capsulotomy)

Group " B " 20 eyes with (linear capsulotomy (endocapsular) technique.

Group " C " 20 eyes with (continuous curvilinear capsulorhexis technique.

All the cases were subjected to posterior chamber IOL implantation.

VISUAL ACUITY : Affected and fellow eyes. Unaided and aided power of glasses. Retinoscopy if possible was done.

ANTERIOR SEGMENT EXAMINATION : Under diffuse illumination slit lamp biomicroscopic examination was conducted. Any active or latent pathology was looked for.

POST ERIOR SEGMENT EXAMINATION : Using the direct and indirect ophthalnoscope whenever possible. Intraocular pressure was measured.

KERATOMETRY, BIOMETRY AND IOL POWER CALCULATION : IOL power calculation was done using A-scan Ophthalmic Ultrasound. Corneal curvature was recorded. The "Sanders-Retzlaff-Kraff" (SRK) regression formula was used to calculate the power.
Informed written consent was taken from every patient after the procedure had been explained.

PREOPERATIVE PREPARATION : After the routine preparation of the eye prior to surgery, the pupil was dilated with the instillation of a drop each of

Homatrapine 2% and 1% cyclopentolate thrice at intervals of 10 minutes, over an hour prior to surgery. Intensive antibiotic drops were also instilled. Flurbiprofen(0.03%) drop as instilled 6 times at an interval of 20 minutes to prevent peroperative miosis.

LOCAL ANAESTHESIA : All the surgeries were done under local anaesthesia with 2% Xylocaine containing adrenaline (1 in 1,00,000) unless contraindicated and mixed in injection hyaluronidase (50-20 units/ml) was added to local anaesthetic for better infiltration. Digital pressure was given for ten minutes to achieve hypotomy. In hypertensives no adrenaline was used.

SURGICAL STEPS : All the surgeries were performed under coaxial operating microscope. The eye was cleaned and draped. Lid sutures and the superior rectus sutures were passed. Afornix based conjuctival flap was make and haemostasis was achieved by cauterisation. A corneo-scleral groove was made with a sharp razor blade attachment to the blade breaker from 10 to 2 o' Clock and penetrated at 11 o' clock. Methylcellulose (Visilon) was injected to form the anterior chmber.

After this step different procedures were followed for different types of Anterior capsulotomy.

IN-THE-BAG POSTERIOR CHAMBER IOL IMPLANTATION BY ENVELOP TECHNIQUE :

Using the bent 26 gauge needle a horizontal incision in the anterior capsule was given at the junction of its upper one third and lower two thirds. Thus an opening was made in the capsular bag while still retaining an upper and a lower anterior capsule flap.The corneoscleral section so as to achieves an adequate opening for the delivery of nucleus. The nucleus was delivered by sliding technique by gently pressing on the posterior lip of the corneoscleral section with a lens spatula. A gentle pressure aided the delivery at 6 o' Clock limbus with a lens hook and a slight tightening of the superior rectus suture. The superior rectus suture was released when the nucleus came in between the lips of the corneoscleral incision.Aspiration of the residual lens matter was carried out using a Simcoe two-way cannula, which allows simultaneous infusion and aspiration. The irrigating fluid used was Ringer lacted solution. The rate of flow of irrigating fluid was regulated so as to maintain a well-formed anterior chamber during the cortical aspiration.The cannula was introduced in the anterior chamber in between the anterior and posterior capsular leaves and all loose debris were aspitated first. The equatorial cortex was aspitated starting from 6 o' Clock position of anterior or posterior capsule.After the aspiration of cortical matter was completed, methylcellulose was injected in between the capsular flaps so as to inflate the capsular sac and to

protect the corneal ecdothelium while IOL insertion.All the interaocular lenses used in this study were of the loop single piece PMMA with 6mm optic diameter with a 10° forward angulation of the loops.The IOL was held with a Kelman-McPherson forceps near the junction of superior loop with optic, keeping the convex surface anteriorly. The inferior loop was passed through the inferior capsulotomy and was seen to pass behind the interior capsular flap. The superior loop was then held near its tip and pushed along its axis so as to rotate the lens to a transverse position. The flexing of the superior loop was accompained by a movement of pronotion at the wrist, which ensured that the superior loop would pass behind the anterior capsular flaps. The IOL was dialled, if necessary, using a Sinskey hook to bring the loop transveresly and to correct the centration of the IOL in the pupil.Two vertical cuts were made in the anterior capsule from the two edges of the horizontal anterior capsulotomy using the capsulectomy scissors. One edges of the horizontal anterior capsulotomy using the capsulectomy scissors. One edges of the anterior capsule flap was held with a Kelman McPherson forceps and the anterior capsule was torn and brought out of the anterior chamber.

TECHNIQUE OF CAPSULO PUNCTURE

In these cases the anterior capsulectomy was done using the " Capsule puncture " technique. The bent 26 gauge needle was passed across the anterior chamber to the 6 o'clock position series of communicating punctures were made in the anterior capsule to 12 o' clock on the surgeons' left hand side. The needle moved back to 6 o' clock and procedure repeated to the surgeons' right hand. A wide round anterior capsulectomy as thus achieved by connecting the uncut side towards cut side.

After extending the corneoscleral section, the nucleus was delivered in the same way as described earlier. The residual cortical matter was aspirated using 2-way cannula.During the IOL insertion the inferior loop was passed behind the iris + capsule remnants seen inferiorly. The superior loop was held near its convexity cleared the edge of the pupil the lip was then released so that superior loop passed behind the iris capsule remenents the IOL was dialed if necessary and centration corrected.

TECHNIQUE OF CAPSULORHEXIS

The technique used was as described by H.V.Gimble in the modified form. A bent 26 gauge needle was used as a cystostome a single

puncture was made towards the center of the lens capsule and than gradually guided the tear radically towards 3 o' clock periphery then turning the tear in an arc manner and continuing around the center counter clock wise best control of the tear was achieved by gaining a hold at the place were the capsule was tearing. While completing the capsulotomy it was made sure that the two ends of the tear overlap from the outside in towards the center and not from the center towards outside. Then to deliver the capsule after surface cortex aspiration. The fluid dissection was usually maintained to confirm that it has freed the nucleus. Thus global hydrodissertion of the nucleus was injected under the anterior capsule at 9 o' clock thus building up pressure inside the capsule behind the nucleus this resulted in lifting the nuclear pole of opposite side out of the bag. The cannula positioned under the nuclear pole, which is out of the bag and rotated using the nucleus to 12 o' clock. Thus bring most of the nucleus out of the bag wasat this stage slight was pressure at 12 o' clock to deliver the nucleus and the cortical matter aspirated mixed injected in the bag. The IOL was inserted in the bag with the inferior haptic going behind the anterior capsular rim the superior thereafter introduced in a dialling, fashion so as to release the sup. Loop behind the capsular rim. the fixation was confirmed by visualising the intact rim of capsule in front of IOL optic.The corneo-scleral section was then closed with 10-0 monofilament nylon using the continuous shoelace saturing technique. The suturing was started from the

right hand side of the incision taking only a scleral bite at this end of the incision radical bites were then taken until the opposite end was reached. The suturing was then reversed and continued to the starting point where the last bite passed through the corneal edge of the incision.

Before these sutures were tightened methyl cellulose was washed from anterior chamber and pupil constricted over the IOL with interchamberal pilocarpine (0.05 %). The sutures were now tightened taking care to produce an even tension in the wound and to prevent gaping of the corneo-scleral section. The suture ends were then tied and the knot buried in the groove of they corneoscleral section.

A subconjunctival injection of 0.5 ml each of gentamicin and dexamehasone was given at the end of the surgery.

PEROPERATIVE ASSESSMENT : Involved all complications occurring with their respectice management and the rate at which they occurred were noted in a systematic fashion.

POST OPERATIVE ASSESSMENT : Post-operatively the patients were given systemic antibiotics: local steriod-antibiotic drops were started from the first post-operative day. The pupil was kept mobile with

Cyclopentolate 1% instilled daily in the operated eye for the first few postoperative days.

Subsequent examinations of the operated eye were carried out on the seventh day, at the end of the three weeks, six weeks and at three months post- operatively and following were note :

Patient complaints

Visual acuity aided and unaided recorded

Slitlamp biomicroscope examination with undilated and dilated pupil to look for signs of inflamation pupillary and iris changes, like Atrophy and tears lens position, posterior capsule status and opacification. Presence and extent of posterior synechia, if any was noted peaking of pupil, pigments if any.

Fundus examination with the direct or indirect opthalmoscope.

Keratometry

Refraction and note Astigamatism made.

Special investigation if required, e.g., fluorescein angiography.

Any other late comlications i.e. opacification of post. Capsule. IOL Decentration. Measurement of decentration and pupillary diameter were done by method described by Colvard. M et all. (1990)

All eyes were dilated with one drop of 1 Tropicamide and one drop of 10% phenylephrine. The eyes were evaluated at the slitlamp and the greatest distance from the IOL edge and thepupillary margin was measured. If the pupil did not dilate beyond the IOL edge in any area, the IOL was considered to have zero decentration. If the pupil dilated beyond the IOL edge but the IOL was equidistant from the pupillary margin all meridians, or if less than 0.25mm were divided into degree of decentration categories in 0.5mm steps, with IOL decentration rounded off and assigned to the nearest 0.5mm category.

The IOL decentration was measured in the following way:

The slitlamp was carefully focussed at the pupillary plane and the slitbeam axis and width was adjusted to match the greatest distance from the IOL edge to the pupillary margin. The patient was then asked to sit back. Without a millimeter rule was grought into sharp focus and measurement was recorded. The same technique was used for measurement of pupillary width. All data was collected and statistically evaluate.

OBSERVATION

OBSERVATION

A total of 60 patients were divided equally in to 3 groups.

Group A:- 20 patients subjected to capsulopuncture technique of capsulotomy with PC IOL implantation :

Group B :- 20 patients subjected to envelop (endocapsular) technique with PC IOL implantation.

Group C :- 20 patients subjected . CCC with PC IOL implantation.

The mean age of the patients in Group A was 62 to 63 yrs. Group B 63 to 64 Group C 60 to 61 yr.

Sex Distribution :

Table :- 1

Group	Male	Female	Total
A	9	11	20
B	11	9	20
C	9	12	20

Other Systemic Disease:

There were 6 patients with systemic hypertension and 4 patient with Diabetes Mallietus. But their status was controlled poior to taking them up for surgery.

Preoperative Visual acuity

Table :- 2

Visual acuity (With Beat correition)	Number of cases		
	Group A	GroupB	GroupC
-- > 6/60	7	6	8
-- fc upto 6 mts	7	8	10
-- HM to PL	6	6	1

Patient with > 6/60 21 case (25%). 25 cases with vision upto fc upto 6m (41.5%), and 14 cases (23.5%) with Vision of HM to PC.

Pre operative Keratometery

The mean preoperative corneal refractive power was calculated in all the 3 groups

Table :- 3

Group	Along the Steeper Meridian (in D)	Along the Flatter Meridian (in D)
A	44.49	43.82
B	44.48	43.84
C	44.55	42.50

Per-operative, Difficulties, Complication:

Graph A : Capsulopuncture

No significant complication or difficulty seen in capsulotomy by capsulopuncture . Most frequently seen observation was anterior capsule tear extension after nucleus delivery in 18/20 (90% cases). Iris sphincter damage was observed in 2/20 cases. Other salient observation in this group were cortical aspiration related problem 3/20 (15%), pigment release was another comman finding 5/20 (20%), 4 cases of peaking of pupil (20%) . Other diffuculities seen were reapted IOL insertion 3/20 cases i.e. (15%) Hyphema in two cases (5%). One case of post capsular (5%) was seen without viterous loss.

Peroperative Difficulty and complication.

Group B - ENVELOPE (ENDOCAPSULAR) TECHNIQUE

This group presented with 1 case (5%) with difficulty in Ant capsulotomy. Major significant finding was anterior capsule tear enlargement after Nuclear extraction 16/20/(80%)cases. Other observation of this group were one case of iris sphincter tears (5%) Difficulity in IOL insertion 3/20 cases (15%) , pigment release 2/20 cases (10%) and one case of peaked pupil 5%. 1/20 cases (5%) was with post capsular plaque which would not be removed during surgery 1/20 cases of Hyphema (5%).

Peroperative Difficulty and complication

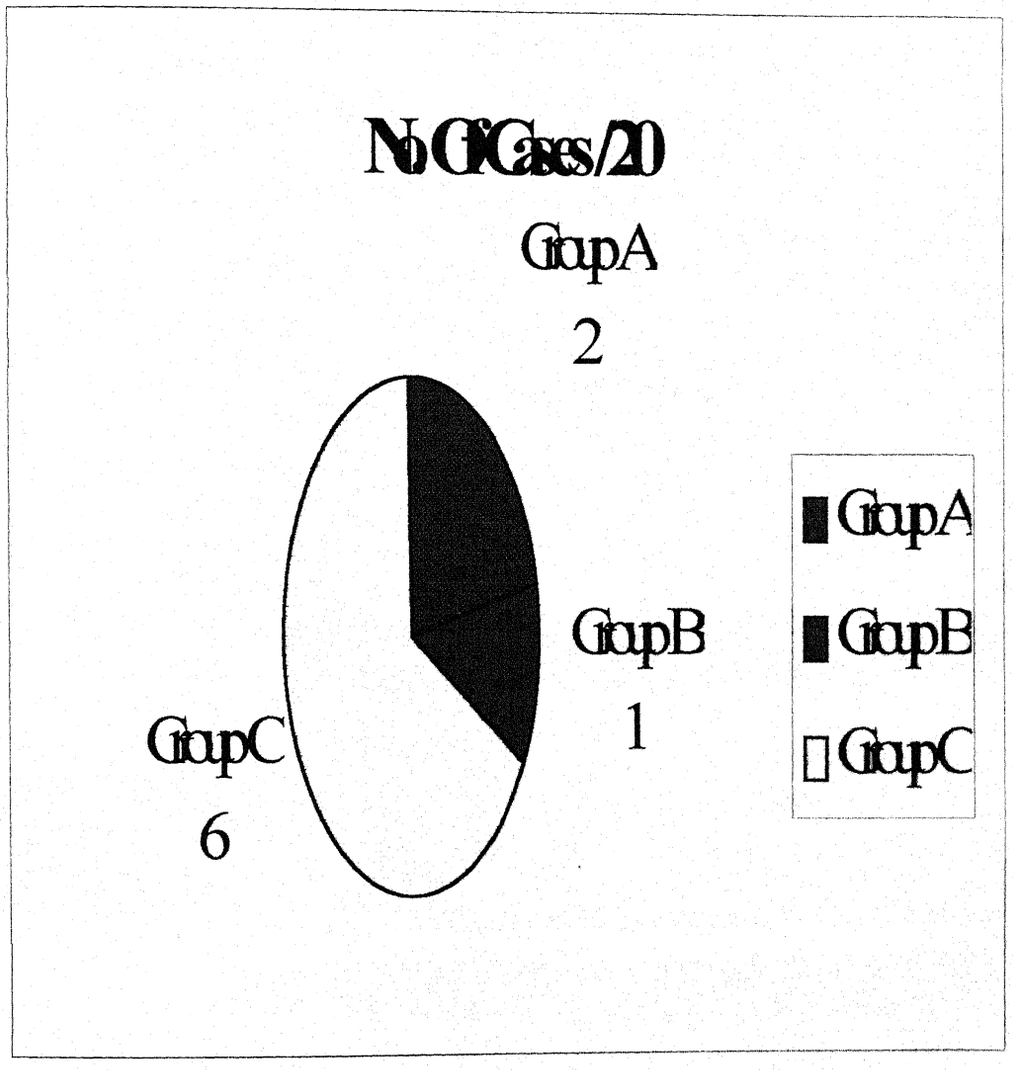
Group C Countinous Curvilinear Capsulorhexis (CCC)

This group presented with significant difficulty during capsulotomy 6/20 cases (30%) with 3/20 cases of uncontrolled anteriorcapsular tear (15%).Major difficulty encountered during nuclear extraction in 8/20 cases (40%) resulting in ant capsule tears enlargement, in 4/20 cases (20%) ; other observation in this group are -

(i) Difficulty during IOL insertion 2/20 cases (10%)

(ii) Ant capsular tear during IOL insertion in 1/20 cases (5%)
(iii) Pigment release 5/20 cases (25%) cases with reapted IOL insertion and centration . one case (5%) of post capsular plaque which could not be removed surgically.

DIFFICULTY IN CAPSULOTOMY



DIFFICULTY IN CAPSULOTOMY
NO. OF CASES / 20

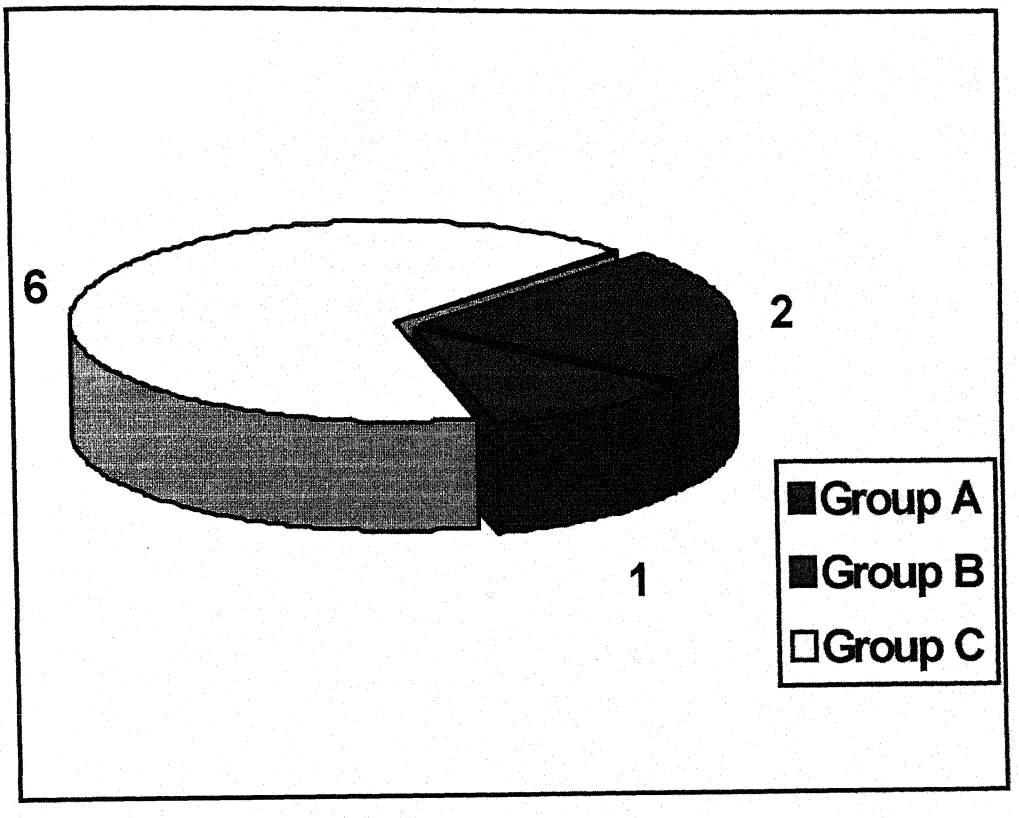


Table :- 4

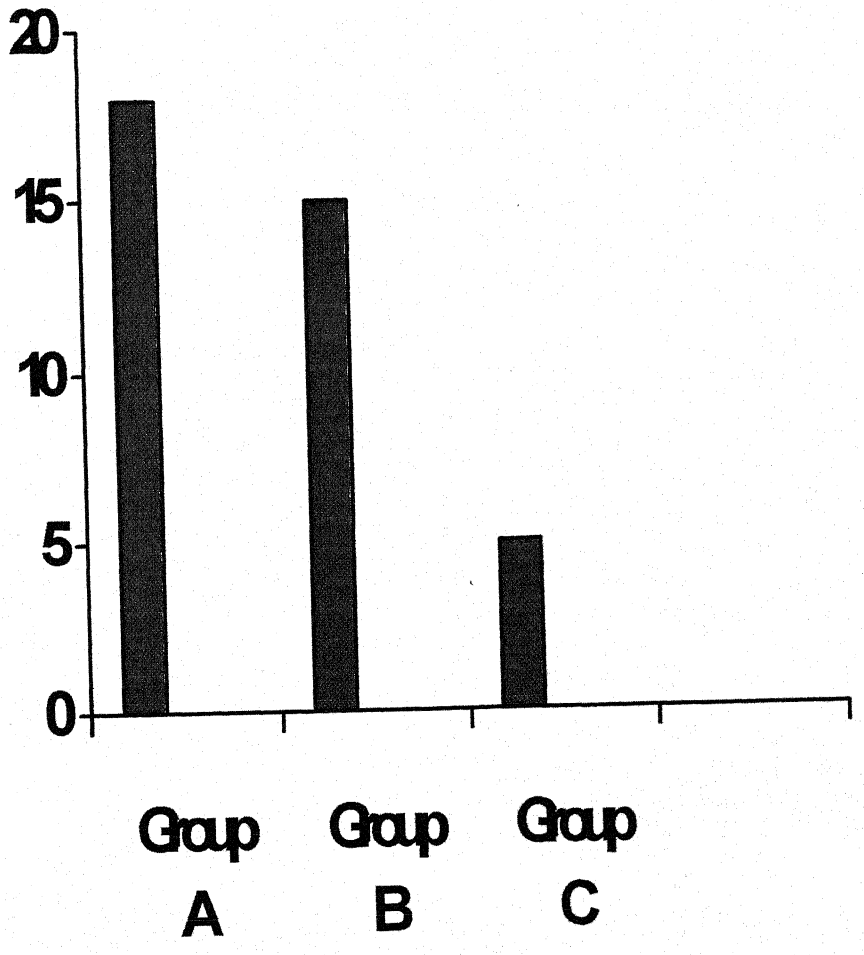
PeroperativeDifficulty&Complications

Technique

No cases with Difficult/Complication

	Group A	GroupB	Group C
1. Capsulotomy.			
(a) Difficulty	2(10%)	1(5%)	6(30%)
(b) Torn Ant capsule	nil	nil	3(15%)
2. Neuclear extraction.			
(a) Difficulty	2(10%)	1(5%)	8(40%)
(b) Accident Intracapsular	nil	nil	nil
(c) Anterior capsular tear enlargement	18 (19%)	16(80%)	4(20%)
(d) Iris sphincter damage	2(10%)	1(5%)	nil
3. Cortical aspiration.			
(a) Entanglement of capsule remanents	3(15%)	nil	nil
(b) Post. capsular rent	1(10%)	nil	nil
(c) Viterous loss	nil	nil	nil
4. IOL Insertion			
(a) Difficult	3(15%)	3(15%)	2(10%)
(b) Stripping of Descements	nil	nil	nil
(c) Pigment release	5(25%)	2(10%)	5(25%)
(d) Difficulties in centration	4(20%)	2(10%)	1(5%)
(c) Hyphema	1(5%)	1(5%)	nil

NO. OF CASES WITH CAPSULE TEAR DURING NUCLEUS DELIVERY



Post operative complication

Early post operative complication (less than 4 wks) in 60 cases.

Transient striate keratopathy with corneal oedema occured in 12 cases out of 60 (20%) wound gape was seen in one patient (1.66%) not associated with wound leak or shallowing of the anterior chamber in the post operative period. Hyphema was seen in 2 cases (3.2%) when cleared up 7 days.

Pigment release was noticable in 7 cases (11.5%) clearing up by 7 day pigment deposit on the lens was seen in 11 cases (17.1 %) significant iritis seen in 2 cases (3.2%) which persisted till 1 wk and left it sequalae in one of the cases as posterior. Synachiae lens precipitate or lens matter remanents were observsed in 3 cases. Peaking of pupil was observed as 5 cases (8.4%)

Early Post Operative Complications in 60 Cases

Sl No.	Complications	Group A	GroupB	Group C	Total (60)
1	Straite Keratopathy with corneal ocdema	4(20%)	3(15%)	5(25%)	12(20%)
2	Wound gape	0	1 (5%)	0	1 (1.6%)
3	Shallow A/C	0	0	0	0
4	Hyphema	1(5%)	1(5%)	0	2(3.3%)
5	Pigment relase	3(15%)	1(5%)	3(15%)	7(11.5%)
6	Pigment depositon on lens surface	4(20%)	1(5%)	2(10%)	7(11.5%)
7	Lense precipetate or cortical matter	2(10%)	1(5%)	0	3(5%)
8	Peaking of pupil	3(15%)	2(10%)	0	0
9	Iris prolapse	0	0	0	0
10	Iris sphincter tear	2(10%)	0	0	2 (10%)
11	Viterous in A/C	0	0	0	0
12	Endophthalents	0	0	0	0

Late post operative complication in total 60 cases

Oval deformation of pupil was seen in 8 cases (13.3%) , 4 of these cases (8.6%) were seen with iris atrophy pupillary capture was seen in 1 case (1.6%). Residual cortical matter was seen in 4 cases(6.6%).

Lenticular precipipates were seen in 4 cases (6.6%) Posterior capsular thickning was seen in 12 cases (20 %) cases but in all cases the opacification was present only mainly in perphery away from visual axis. 2 Cases of capsular plaque , 1 case (1.6%) of cystoid nuclear oedema.

Late Post Operative Complications in 60 cases

Sl. No.	Complication	Group A (20)	Group B (20)	Group C (20)	Total (60)
1.	Persistant Corneal Oedema or bullous Keratopathy	0	0	0	0
2.	Posterior Synechiae	2 (10%)	1 (10%)	0	3 (5%)
3.	Filamentary Keratitis	0	0	0	0
4.	Peaked pupil /or Oval Deformation	4 (20%)	3 (15%)	1 (5%)	8 (13%)
5.	Pupillary Capture	1 (5%)	0	0	1 (1.6%)
6.	Iris Atrophy	2 (10%)	1 (5%)	1 (5%)	4 (6.6%)
7.	Residual Cortex	2 (10%)	1 (5%)	1 (5%)	4 (6.6%)
8.	Endothelial Pigmentation	1 (5%)	1 (5%)	0	2 (3.2%)
9.	Lens Precepitate	2 (10%)	1(5%)	1 (5%)	4 (6.6%)
10.	Post Capsular Thickning	5 (25%)	5(25%)	2(10%)	12
11	Cystoid macular edema	0	1(5%)	0	1(1.6%)
12	RD	0	0	0	0
13	IOL Tilt	1(5%)	1(5%)	0	2(3.2%)

Pupil Abnormalities

Table :- 5

	Group A	Group B	Group C	Total
(1) Iris atrophy	2	1	1	4
(2) Torn sphincuter	2	1	0	3
(3) Iris prolapse	0	0	0	0
(4) Pupil capture	1	0	0	1
(5) Oval deformation	1	2	0	3

Posterior Synechiae

Table :- 6

	Group A	Group B	Group C	Total 60
Incidence	2(10%)	1(5%)	0	3
Site	4 O' clock 8 O' clock	11 O' clock	0	
Extent	<1	1	0	

TILT OF IOL

The telting of the IOL could be apreciated on slit lamp biomicros copy in 2/60 cases (3.3%) Both the cases showed one haptic in the capsular bag and other haptic infront of the capsular flap (asymetric placement of the IOL).

Position of the loops of the IOL

A CapsulopunctureGroup. [Group A]: Both the loops could be seen in front of the capsule remanent 6 cases (30%) but atleast one haptic loop could be seen in all 20 cases in front of the ant capsular remanent. The other loopwas not visualised.

B Envelop (endocapsular). [Group B]: Both the loops of the IOL could be seen in the bags in 7(35^%) of cases. One case showed one loop in the bag and other in the region ant. to the capsular remanent, In 12 of the other cases (60%) only one loop could be ascertained to be in the bag wheares other loop could not be visualised.

C Capsularhexis. [Group C]: 12 cases showed 60% in the bag placement of both the loops one case (5%) showed asymtrical placement with one loop out of the bag through the anterior capsular radial tear rest 7 cases (35%) only one loop could be visualised as being placed in the bag. Other loop nor being visualised.

Post operative visual acuity (12wk)

Corrected post operative visual acuity at 12 wk showed 36 cases (60%) with 6/6 vision, 13 cases (21.6%) with 6/9 vision, 9 cases (15%) with 6/12 Vision. Cases with 6/12 or worse Vision were only 2 in number (3.3%).

POST OPERATIVE VISUAL AQUITY (12 WEEKS)

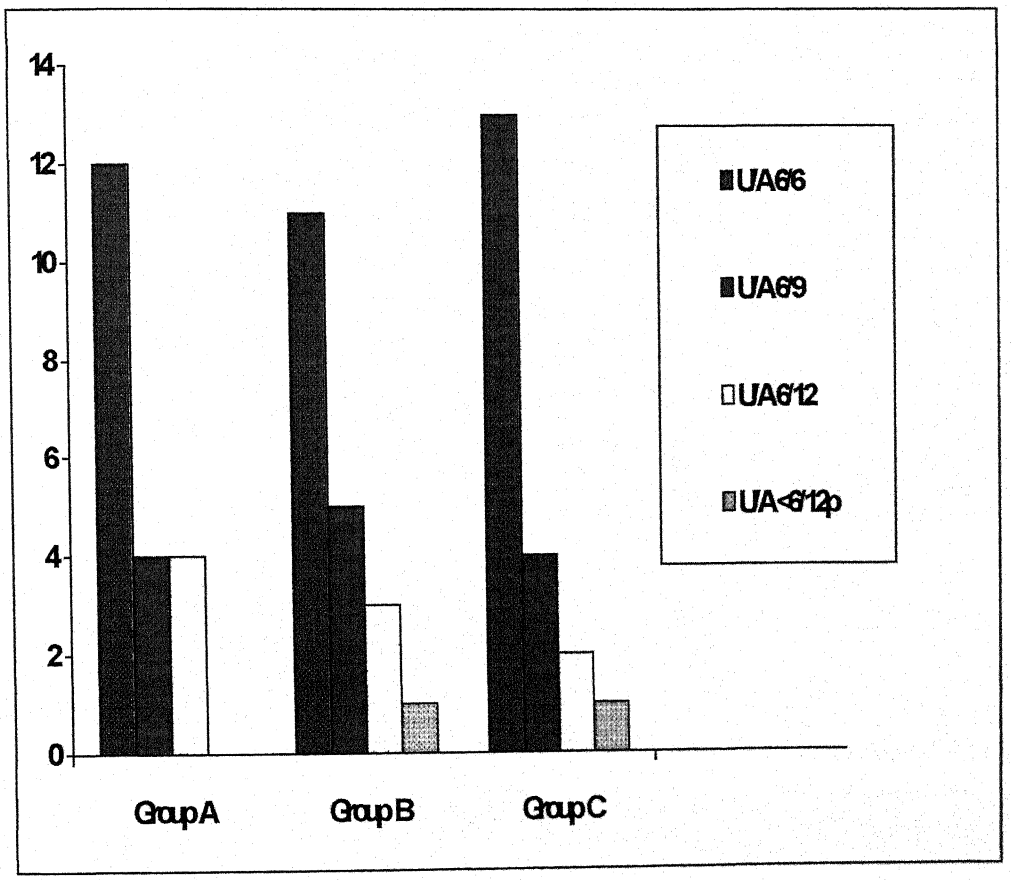


Table :- 7
Post operative visual acquity (12wk)

Correated U/A	Group A(20)	Group B(20)	Group C (20)	Cases
6/6	12(60%)	11(55%)	13(65%)	36(60%)
6/9	4(20%)	5(25%)	4(20%)	13(21.76%)
6/12	4 (20%)	3(15%)	2(10%)	9(15.5%)
<6/12p	0	1(5%)	1(5%)	2(3.3%)

Surgical induced Astigmatism

The corneal astigmatism as found out by keratometery was found to change postoperatively. The surgically induced astigmation was calculated by using the law of sines and cosines man. All cylinders were transposed to minus form. Details of surgically induced astigmatism in different groups at different time interval are shown in table given below.

Change of corneal Astigmatism [Group A]

Table :- 8

	Surgically induced corneal astigmatism (in D)	Range
Preoperative	1.042	0-2.5
2nd day	4.01	1-6.51
6wk	2.30	0.25-5.94
12 wk	1.82	0.25-3.25

Change of corneal astigmatism [Group B]

Table :- 9

	Surgically induced corneal astigmatism	Range
Preoperative	1.108	0-2.25
2nd day	4.41 D	1-7.48
6 wk	2.43 D	0.5-4.14
12wk	2.28 D	0.75-3.89

Change Corneal astigmatism [Group C]

Table :- 10

	Surgically induced corneal astigmatism (in D)	Range
Preoperative	1.02 D	0- 2.5
2nd day	4.12 D	1.26-6.75
6 wk	1.89 D	0.35-4.12
12wk	1.81 D	0.39-4.12

Astigmatism by Retinoscopy

This astigmatism as determined by retionoscopy at 6 wks was compared with the actual corneal astigmatism at the same time.

Table :- 11

Comparision of Astigmatism As Determined by Refraction, with the corneal astigmation at 6 wks.

Group	Actual corneal astigmatism at 6 wks (in D)	Astigmatism by Retivescopy done at 6 wks(in D)
A	2.13	3.36
B	2.25	2.85
C	1.72	1.30

DISCUSSION

DISCUSSION

Visual rehabilitation of an aphakic eye by spectacles causes a considerable limitation of the visual field , spatial disorientation and in unilateral aphakia , results in an intolerable binocular diplolia . contact lenses can be benificial to some extent but they carry the problem of fitting and maintanance of proper hygeine during frequent in sertion and removal . The dry , hot and dusty enviornment in our country puts further limitations to the usefulness of contact lenses for aphakic correction . Advanced refractiive surgical procedure like keratophakica , keratomelusis (Barraquer 1980) and epikeratophakia (Kaufmen 1980) are available only at a limited number of centre and have their own limitations keeping in view all these factors the intraocular lens with its optical advantage over other method of correction , remains the best method for correcting aphakcia .

The introduction of IOL implantation by Ridley heralded a new era in the management of aphakia . He choose posterior chamber as the site of implantation of his IOL . However , his implant were associated with iritis ,hyphema glucoma,lens dislocation (Riddey 1960) . These complications with Ridleys original implant led to attempts to place the pseodophakos in the anterior chamber using the angle recess for fixation & iris

supported lenses . Although good intial result were documented following these implants , longer follow up revealed the complication of atrophy and errosion of occular tissue , corneal decompansation leading to psedophakic bullous Keratopathy , cellular proliferative reactions, subluxation and dislocationof lens and complications related to loop materials eg. Biodegradation of nylon were seen these lead to numerous modification in the design of IOL . The most notable achivement of the past decade were the replacement of nylon loops by prolene of PMMA and return to post chamber IOL .

Shearing orginal J loop post chamber IOL has undergone a few modification that have resulted in added flexibilty and better fixation and cetration . The 10degree angulation of loops has placed the optic of IOL further away from iris and cornea . However the quest for better lens designs materials and technique continues .

In Bag Fixation /s Sulcus Fixation :- The loops of a posterior chamber IOL can be fixation either in the ciliary sulcus or in the capsular bag . Initially the posterior chamber lenses were placed behid the iris , presumptively in the ciliary sulcus with good clinical results . Hoffer (1981) said that the site of fixation of the posterior chamber IOL loops was only of theoretical interest and the final post operative results were equally good with both the fixation site .

However , recent studies have been conducted which show the adverse effect of sulcus fixation on the blood aqueous barriers (Miyake et al 1984) post mortem histopathological studies (Oslon 1980 , Apple et al 1984 , Mc , Donnell 1987) have also supported the fixation of IOL loops in capsular bag .There has been a suggestion that " in the bag " fixation lead to better contraction and delays posterior capsular opacification (nishi 1986 , Hansen 1988) .

An attempted sulcus fixation frequently leads to an asymetrical placement of loops (Hansen et al 1988 , MC Donnell et al 1987 , Miyake 1984) which is responsible for IOL decenteration and tilt (MC Donnell et all . 1987 , Hansen et al 1988). The IOL tilt has been shown to give rise to astigmation (Jalies , 1978) and IOL dicenteration may give rise to subjective visual complaints (Brens et al 1986) .

Amongest the method of in the bag placement of the IOL CCC is a new technique developed by Gimble HV ,Neuhan (1990) . This method of anterior capsulotomy is said to assure a 100% confirmed in the bag placement this assure all the benifits of in the bag placement which might not be garenteed in envelope technique .

Assia et al . in a comparative study of various capsulotomy technique have found a 100% tear formation in the anterior capsule during necleus delivery

in all other techniques of capsulotomies except capsulorehxis technique showed 0% tear formation .

In present study we have compaired the postoperative visual results , complication and asigmatism in patient with in the bag posterior . chamber IOL and ciliary sulcus fixated IOL . In addition we have attempted to established the fact of superiority of CCC over other methods of capsulotomy with planned ECCE along with above observations .

The Design of the Study :- It was a prospective study of randomly distributed 20 cases each of post chamber IOL with fixation in capsulopuncture and in the bag by endocapsular and CCC technique .

Methodology:-

Surgical techniques :- Simple capsulopuncture which is widely practised all over was used . The technique we use for CCC is a modified technique described by Gimble H.V. (1990) and technique used for nucleus delivery as described by Paudey A.M. (1993) the advantage of capsulorhexis is a technique in its own right are namely -

I) Assured used in the bag placement

II) Reduced incidence of PCO

III) Facilitation of endolenticular Phacoemulcification

IV) No interference with lom edges of anterior capsule during aspiration . (Gimble H.V. 1990) . We

have used . The endocapsular technique of extra capsular cataract extraction for implantation of the IOL with in the capsular bag in Group B . The biggest advantage of this technique is that it enables cortical aspiration with out sacrifycing the anterior capsular flaps. Therefor , at time of IOL insertion the loops can be a correctelly passed between the anterior and posterior capsular leaves and capsular bag fixation could be ensured is almost all the cases. Hansen et al (1988) have also shown complete capsular fixation of all the IOL s implanted by this technique .

We used the posterior limbal bevelled incision for entering the anterior chamber this is based on the fact that an incision further away from the optical zone of the cornea reduces the post operatively astigmatism (Jaffe) .

INFERENCES

AGE & SEX : We observed no significant difference in the mean age and sex distribution in the three groups , however the mean age of about 58 to 61 years in the 3 group is due to the fact that cataract occures at a relatively younger age in Indian then in the causcasian population as in suggested in the Framenghan eye study (Kini et al) .

Pre operative Visual Acquity :- A preoperative visual acuity of 6/60 or more was present in 21 cases (35%) . Visual acquity of finger counting up to 6m was present

in 25 cases (41.5 %) and it was reduced to the level of HM or PL only in 7 cases (23.5%) .

Corneal Astigmation :- The mean preoperative corneal astigmation was determined by keratometery , 3 of the eyes in this study had no preoperative astigmation with the rule and againest the rule astigmatism was seen in 28 eyes each .

Intraoperative Complication :- An important problem during surgery was presence of posterior subcapsular paques which could not be removed at the time of surgery (15.5%) in one of the case a dense posterior sub capsular plaque in the visual axis did not allow the final postoperative visual acquity to improve beyond 6/12 .

An inadvertent rent in the posterior capsular of occured in one of our cases (5%) belonging to group A Pearce (1979) has reported a 6.8% incidence of inadvertent poaterior capular rent in 444 cases of senile cataract while Maumence and Spark et al (1984) have reported a rate of 14% in 1041 adult eye .There was no incidence of viterous loss in our case . Acheson et al (1988) have reported have incidence of 2% in 100 eyes.

Intra operative sphiucter tear occured in 3 of our cases 2 in group A and 1 in group B same damage to the sphincter mechanism resulting is minimal pupillary shape in 6 other cases (13.3%) . There the damage to the sphincter mechanism probebly occured at the time of

nucleus delivery because of a rigid pupil or at the time of aspiration in diabities cases . Where pupillary dilatation was not adequate .

Postoperative Complications:-

1. Straite keratopathy with Corneal Edema :- In 12 of our cases 20% we abserved a transient straite keratopathy with corneal edema of these 12 cases 4 were seen in group A , 5 cases in group C and only one case in group B . We did not have any case of persistent corneal edema or pseudophakic Bullous Keratopathy , Stark et al (1983) have reported a 0.6% incidence of persistent corneal edema . The incidence of pseudophakic bullous keratopathy have been reported to be in a range of 1-2 % (Stark et al 1983 , Drews ,1978) the decresed incidence in group B was probably due to protective effect of ant capsular flaps to the corneal endothelium (Galaud A. 1983)

2. Pupalliary Block Glucoma :- We observed no case of pupillary block Glucoma .

3. Wound Gape :- A Slight wound gape occured in one of our case (1.6 %) belonged to Group B but this was not significant enough to cause any wound leak , sallowing of ant. Chamber , distortion of the pupil it probably occured because the suteres were left a little loose in an effort to reduce the postoperative with the rule corneal astigmatism .

4. Iris Atrophy :- It was seen in 6 cases (13.3 %) the incidence of iris atrophy , in a series is higher Group C capsulorhexis 13.3 this is because of the greater contact and rubbing of anterior iris surface during increased intraocular manupulations while doing capulorhexis the atrophy in these cases was typically seen at or near the site of entry of the capsulotomy needle 10 % cases of group A showed iris atrophy probably due to rubbing of post surface or ciliary sulcus fixated post. Chamber lens . We observed post. Synechia in 3 cases (5%) in our series .

5. Cystoid Macular Edema :- Resulting in dimunition of visual acuity to 6/24 occured in one case with capsular bag fixated posterior chamber IOL in group B 16 weeks postoperatively .

6. Late Postoperative Hyphema :- There was no case of late postoperative Hyphema or endophthalmetis in our series . Incidence of late postoperative hyphema has been reported 0.3 % (Stark et al 1983) and 1 % (Kratz et al) with PC IOL .

7. Post Capular Opasification and retinal detachement :- Our period of observation is too small for a meaningful discussion on postoperative opacification of posterior capsule opacification and retinal detchement , We observed all post.capsulae thickening in 12 cases (20%) but it was present in the periphary, away from the visual axis in 11 cases and in 1 case it was associated with a

denece posterior subcapular plaque which could not be removed surgically . we did not see any case with postoperative posterior capsular opacification in the visual axis nor did we see any case of RD in the short follow up period posterior capsular opacification has been reported upto 50% of patients after three to five years of ECCE (Nishi, 1986, MC Donnell et al , 1983, Siusky 1978, Lind storm, 1980)

Retinal Detachment has been reported in .55% to 1.65% of eyes following ECCE with IOL implantation (Binkhorsh 1976, Srider 1977)

Final post operative VA :

A final post operative VA of 6/9 or better was seen in 81.7% of all the cases who under went IOL implantaion 1/20 cases in Group B implantation (5%) had a final post operative VA of 6/24 due to development of CME . 1/20 cases to Group C IOL (5%) had final post operative VA of 6/24 because of a posterior subcapsular plaque in Visual axis

Our results compre favourably with reported in literature Kratz et al 1981 have reported final VA of 6/12 or better in 91% cases Stark et al (1983) reported a final VA of 6/12 or better in 88% of cases with PC IOL .

Post operative astigmatism :

After catarct extraction with IOL implantation the post operative astigmatism has 2 component the surgically induced Corneal astigmatism and astigmatism due to IOL

In this study we have attempted to find out the difference between to corneal astigmatism and the total astigmatism determined by retinoscopy . The discrepancy between the two would give a estimate of the IOL induced astigmatism .

Surgically induced corneal astigmatism :

Can be determined by calculating the difference between preoperative and post operative astigmatism .

Our obseravtion that the surgically induced astigmatism fall rapidly from 2nd post operative day to the sixth post operative week and there after the fall is very gradual upto 12 weeks . Corraborates with the observation by Cravy (1989) .

There was no significant difference in the surgically induced corneal astigmatism in any of the three groups.

Astigmatism by Reinoscopy:

The distinction between astigmatism by retinoscopy and that determined by keratometry becomes espicially important in higher degrees of astigmatism found after cartarct surgery with or without IOL implantation (Taffe) In an Aphakic eye the spherical equivalent of the repactive error is a strong 'plus' sphere the effectivity of which increases with the vertex distance of specticales the higher the vertex distance greater the effectivity of the lens and smaller the cylinder required so in the eye with a high plus spherical equialent the cylinder required in specticales in the lower power than what is suggested by the keratometery on the other end in a psedophakie eye we tend to overcorrect the patient to make him a low myopia . So the spectical cylinder will be higher than what is suggested by the keratometery.

We than found the mean discrepancy (between corenal astigmatism and total astigmatism) to be the most significantly incresed in Group A Capsulopuncture Group A.

We have also observed a significantly great shift in cylindrical error towards a higher value all retinoscopy in group A (Sulcus fixated) then the shift in group B and group C .

SUMMERY AND CONCLUSION

SUMMARY AND CONCLUSIONS

1. The study was carried out on 60 patients of cataract 40 years of age or more to compre the results, complications induced astigmatism with intraocular lens implantation in case of different techniques of capsulotomy capsulopuncture, endocapsulorhexis.

2. Patients were divided in three groups A B and C.

3. Visual acutiy ; keratometry, retinoscopy, and biomicroscopy eye were done preoperatiely and on first third posoperative day and at the end of 3rd week, 6th week and 12 week. In the postoperative period IOL centration and tilt were assessed.

4. A modified T- C loop single piece 6.5 mm PMMA posterior lens was used in the study after an extracapsular cataract extraction, endocapsular technique in group B and CCC was performed in group C, suturing was carried out by 10-0 monofilament shoe lace continuous suturing.

5. Intraoperative complications were posterior capsular rent in 1 case in group A and a sphincteric tear in 3 case, 2 in group A and 1 in group B.

Most notable observation was difficulty in capsulotomy in group C (Capsulorhexies) which presented as uncontrolled tear extension during capsulotomy, this incidence found to reduce in frequency over the peroid of time as the surgical efficiency improved with experience. Thus proving that the difficulty was experience related, whereas the delivery of the nucleus presented with problems during most of the duration of the study till ultimately the capsulotomy size being made was enlarge to 6 to 7 mm.

6. Early poatoperative complications seen were : transient striate keratopathy Group A-4 case (15%) and group C-5 case (25%); minimal woundgape,1 case in group B (5%).

7. Late postoperative complication seen were : iris atrophy 2 cases in group A (10%) one case in group B (5%) one case in group C (5%) the severity of atrophy was more cyctoid macular edema , (1 case in group B (5%) and one in groups A and C; posterior synechiae (2 cases in groups A (10%) and 1 case in group B (5%).

8. Postoperative visual acuity of 6/9 or better was achieved in 16 cases in group A (80%) 16 cases in group B (80%), 17 cases in group C (85%). One case in each in Group A and C had a visual acuity of 6/12 because of a posterior subcapsular plaque and 2 cases in group A due to diabetic maculopathy, 1 patient from group B deteriorated fron a vision of 6/6 to 6/24 after developing

cystoid macular edema. Other patients in group A B & C 2,1 and one respectively had developed mild to moderate PCO who later improve to 6/9 of better after yag later capsulotomy.

9. In the group A where capsulopuncture had been caried out, both the loops could be seen in front of the capsule remanemts in 6 cases (30%) rest 14 were seen to have atleast 1 loop in front of the capsule remanents the other loop not being visible, in group B 7 cases had symetrical fixation of in the bag and in the rest 13 cases only one loop was in the capsular bag other loop not being visualised, in group C 12 cases the position of both loops could be seen in the bag, one case with asymetrical placement 7 cases where in only one could be visualised in the bag the other not being seen.

10. A decentration of 0.5 mm or more was seen in 8 cases (40%) in group A and 6 cases (30%) in group B and 4 cases in group C 20% of these a decentration of 1mm or more was seen only in 2 cases (10%) in each group A and B 1 case in group C.

11. An appreciable IOL tilt was seen in two cases on slit lamp biomicroscopy one case belonging to each group A & B. Both these cases showed an asymmetrical fixation of the IOL. And no such finding was there in group C.

12. Immediate postoperative (day 2) all cases had with the rule astigmation which showed a rapid decay till 6 weeks and a more gradual decay till 12 weeks.

13. The mean discrepancy between the corneal astigmation and astigmatism by retinoscopy is maximum with the sulcus fixation IOLs i.e. group A The discrpancy was observed to be significantly higher than in the capsular bag fixated IOLs of group C.

14. There was no significant difference in and postoperative complications in the three groups.

15. Pseudophakic astigmation is more significant in the capsulopuncture (Group A) than in capsular bag fixation groups. This may be explained by the observation that the decentration of the lens was more common in sulcus fixation (Group A) and may have been assiciated with greater tilting of the IOL.

CONCLUSION

Amongst all the three techniques i.e.

(A) Capsulopuncture
(B) Endocapsular
(C) Capsulorhexis

It was felt that Capsulorhexis is good technique can be utilised only when it is followed by phacoemulcification, otherwise it presents with significant difficulty during nuclear extraction as seen in our study. Since in our country the size of the nucleus is larger and the nucleus being hard with sharp edges compared to western counterpart thus leading to radial tears during nucleus extraction.

The advantage of offered by in the bag placement of IOL can not be assured unless the surgery is carried out on a fairly immature cataract.

Amongst capsulopuncture group (A) and endocapsular group (B), the visual result are nearly the same. Though the decentration is more common in group (A) as compared to other groups. And the mean discrepancy between the astigmation by retinoscopy and corneal astigmatism is also significantly high when group A and C are compared, thus denoting that an IOL induced astigmatism is more in group A, but overall

there is no ultimate advantage as seen in our short span of study as far as clinical outcome is seen and capsulopuncture (group A) scores over other two methods when it comes to simplicity of the surgery.

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